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STEAM GENERATION
POWER GENERATION
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DIESEL & GAS ENGINES
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NOVEMBER, 1941

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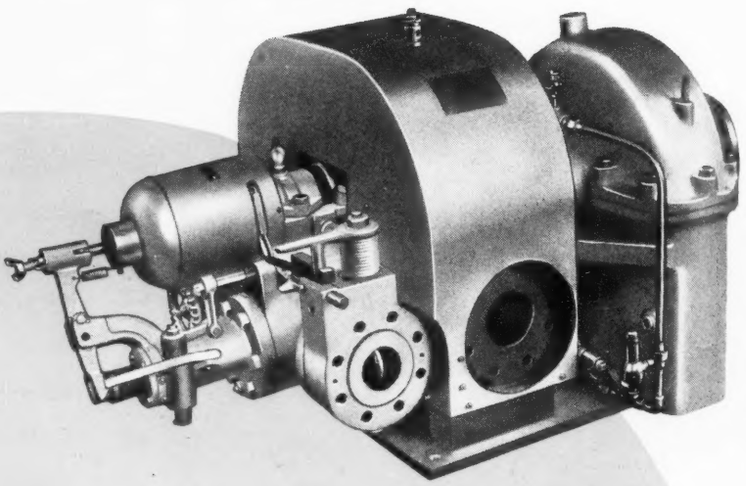
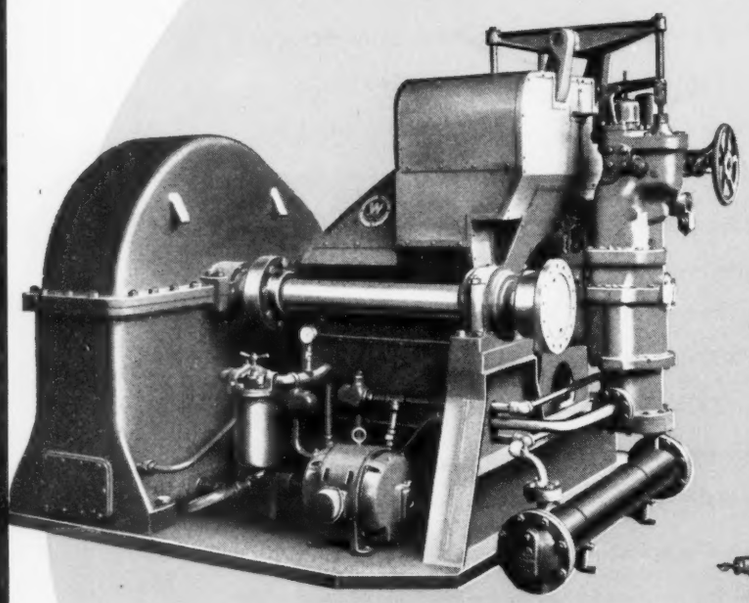
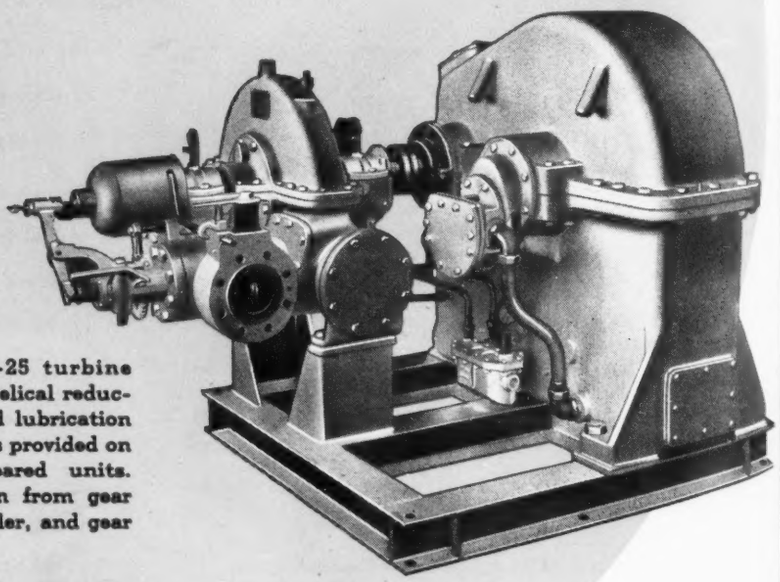
GEARED steam drive



INTEGRAL—Type C-14 single-stage turbine with integral, single-helical reduction gear.



COUPLED—Type M multi-stage turbine, with multiple automatic valves, arranged with a coupled, double-helical reduction gear for paper machine drive. Note double-end gear for connection in middle of lineshaft.

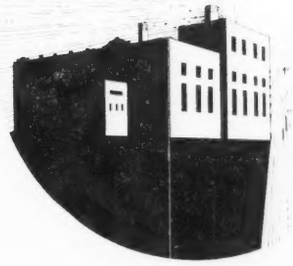


COUPLED—Type C-25 turbine coupled to a double-helical reduction unit. Forced feed lubrication for turbine and gear is provided on all Westinghouse geared units. Note oil pump driven from gear shaft, external oil cooler, and gear base oil reservoir.

Westinghouse

POWER

Established 1882 • PHILIP W SWAIN, Editor



Success With 2500 Lb

About four years ago the news came that a 2500-lb-pressure addition was being planned for the Twin Branch (Indiana) plant of the Indiana & Michigan Electric Co, subsidiary of the American Gas & Electric Co. Somewhat surprising was the announcement that the super-pressure steam would be generated in a natural-circulation boiler. Many an experienced engineer wondered how water could circulate properly at 2500-lb pressure, where boiler water weighs only 4.5 times as much as saturated steam, compared with 16 times as much at 1200 lb.

Operation of the new unit started last March. Experience since then parallels that of many pioneering ventures, in that there were troubles, but not those predicted by the skeptics. A report by Vice-President Philip Sporn states that boiler-water circulation has given no trouble, nor have the high-pressure feed pumps and heaters.

The actual troubles, in no way chargeable to the extreme pressure, and mostly unexpected, included some "oil-whip" vibration in turbine bearings, some carryover causing turbine deposits, and difficulties with control of superheat and reheat temperatures. The bearing vibration has been cured, the turbine deposits brought well under control. No important problem remains except that of steam-temperature control, which harks back to lack of foreknowledge of the extent to which slag would adhere to the heating surfaces, and a consequent unbalance of reheat and superheat. As a result, the plant is still running with an initial steam temperature some 80 degrees below the design temperature. Heating surfaces are being rearranged to overcome this difficulty.

While operation of Twin Branch has not yet been perfected, accomplishments to date fully justify Mr Sporn's statement: "It has been definitely proved that 2500-lb pressure natural-circulation boilers and 2300-lb turbines are technically sound and commercially workable".

Since the ultimate justification of 2500-lb steam must be a fuel saving sufficient to pay charges on the increased investment, it is worth noting that the Twin Branch addition made a net kwhr from an average of 10,282 Btu of coal between May 12 and June 6 and from 10,189 Btu between June 24 and 30. These rates correspond to over-all thermal efficiencies of 33.18 and 33.49 percent respectively. If Twin Branch does no better than maintain these rates, it will take over the world's record for steam-plant efficiency in regular operation.

It is in order to congratulate Mr Sporn, his associates, and the equipment manufacturers on the achievement of another great milestone of utility-plant technical progress. With cautious daring they have taken the chances pioneers must take and have won out.

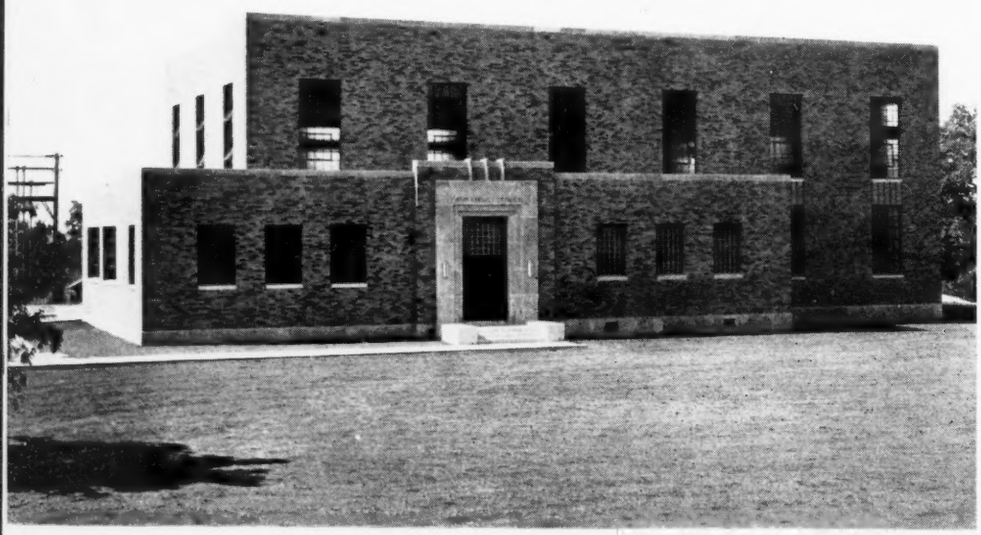
Building Design Key to Diesel-Plant Layout

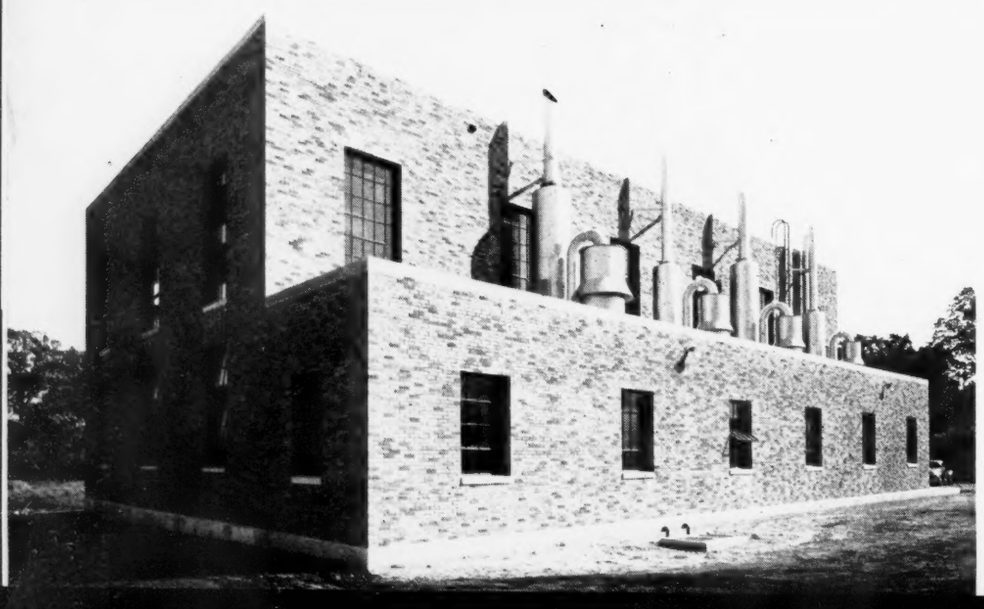
Rigid-frame structure and cantilever floor makes more usable space; intelligent planning puts it to work. Glenn Boyer, Burns & McDonnell Engrg Co, gives full details on trend-setting Algona, Iowa, municipal station

▶ THE NEW municipal electric-generating station just completed at Algona, Iowa, illustrates the strides made during the past decade toward better diesel-plant design and layout. This plant will ultimately house four units with a combined capacity of 2800 kw. Throughout the plant design, simplicity, reliability, operating convenience, accessibility were guiding principles.

Construction of this station for the city's electric utility grew out of the need for additional generating capacity and the inability to house more equipment in the existing station. An examination of the existing power plant indicated that the building was not structurally sound.

For the new station, the city acquired a site adjoining property it owned in the northwest corner of the community. To make the site usable, three houses had to be removed and the property graded down to a predetermined elevation (see plot plan on following spread).





Purchase of a 1500-hp diesel generating unit prior to designing the new building met the need for additional capacity. The new unit, like those to be transferred from the old plant, was built by the Fulton Iron Works Co. New switchgear of greater interrupting capacity was needed and this Westinghouse equipment, together with a new Marley cooling tower, was purchased at the same time as the engine.

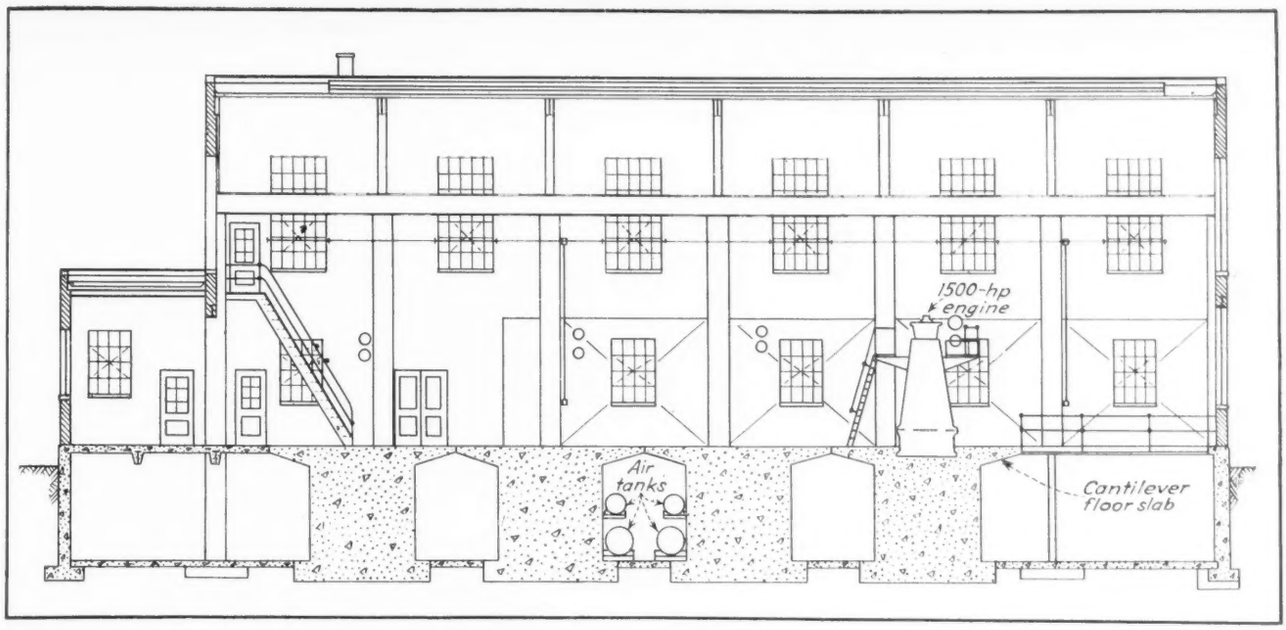
C U Pollard, superintendent, and the designing engineers thoroughly reviewed preliminary designs for the building to insure that operating features were not overlooked and that equipment arrangement and accessibility was all that could be desired. These conferences produced several unusual features, such as rubber expansion joints on the inlet side of end-suction pumps to facilitate inspection and maintenance, a special office for shift operators and helpers, and a small-parts storeroom in addition to the storage space in the basement.

To date, the complete station costs come to $228,864.09, exclusive of expense involved in moving the three units now in the old station. This breaks down by contracts as follows:

Engines	$86,250.00
Cooling tower	6,867.00
Switchgear	23,590.00
Power plant	110,869.59
Grading site	1,287.50

The entire cost of this program was paid for out of surplus funds accumulated by the electric department, making it unnecessary to issue bonds.

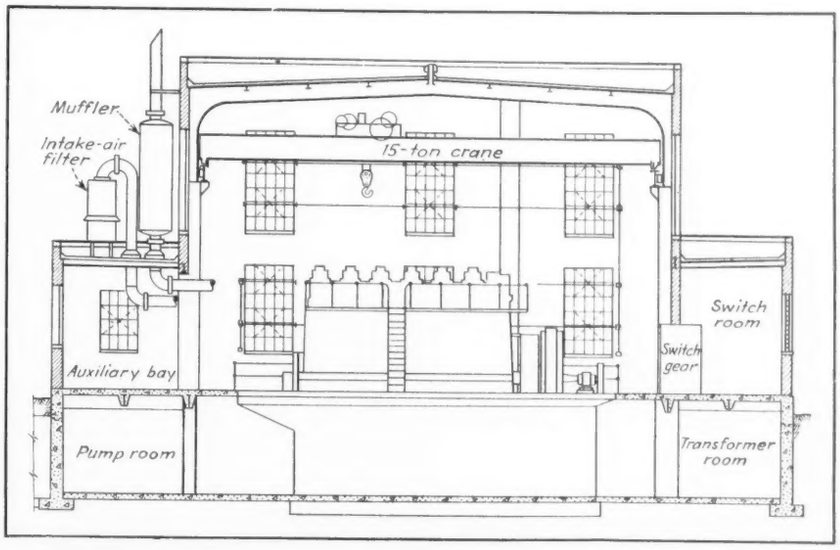
Burns & McDonnell Engineering Co designed the entire project and supervised construction and equipment.

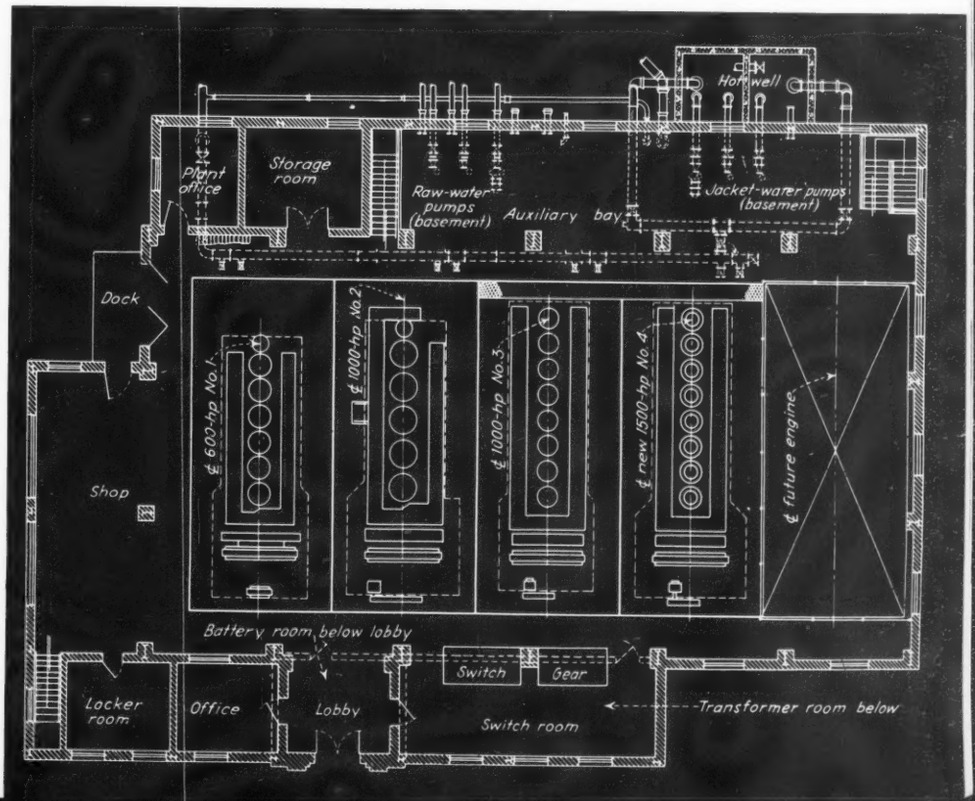


Building design employing rigid-frame construction and cantilever floor slabs permits maximum effective utilization of space and makes it possible to remove any unit and its foundation for replacement with a larger engine, without need for altering the building proper. Engines stand on individual 10-ft wide foundation blocks, 18 ft center to center. Cantilever floor slabs, forming an integral part of the engine foundation at either side fill the 8-ft space between foundations and with similar slabs at engine and generator ends, form a continuous floor at operating level. Thus the basement under the entire engine room, 51x96 ft, is devoid of any floor-supporting columns or beams. This permits running necessary oil, air, water and other auxiliary piping with almost no interference.

Reinforced concrete was employed for the substructure and operating floor; the superstructure is of brick and structural steel. Designing the steelwork as a series of rigid frames eliminated conventional roof trusses, permitting better utilization of full engine-room height (21 ft under the crane hook). Selection of a 15-ton Shaw-Box single-motor traveling crane proved advantageous in erecting the new unit and will again prove its value when the three units from the old plant are installed in the new building.

Along the front of the building is a single-story wing which houses the switchboard room, main plant office and wash room. To the south stands a single-story structure, 14x46 ft, used for a plant shop. At the southwest corner of the engine room a double door and ramp permits driving trucks a sufficient distance into the plant to use the crane

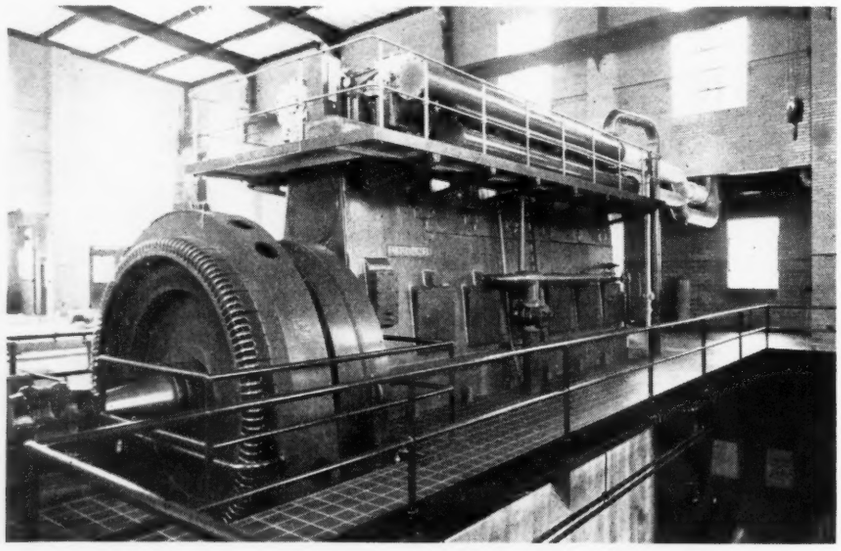


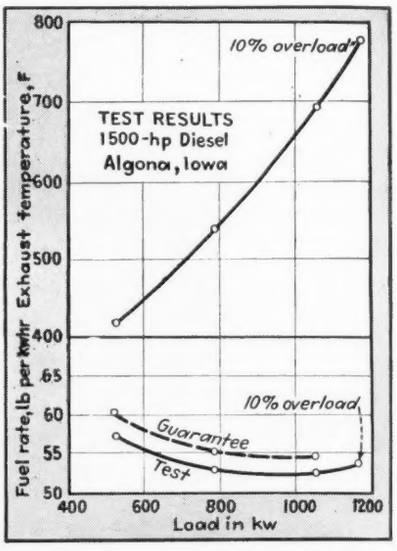


for removing heavy parts or equipment.

A single-story structure on the west side of the engine room, 14x96 ft, houses the operators' office, small-parts storeroom, air compressors, lubricating-oil-conditioning and miscellaneous equipment. The basement section underneath encloses the raw- and soft-water pumps, fuel-oil transfer pump, and auxiliary heating boiler. The roof of this section carries the American intake air filters and the Burgess mufflers.

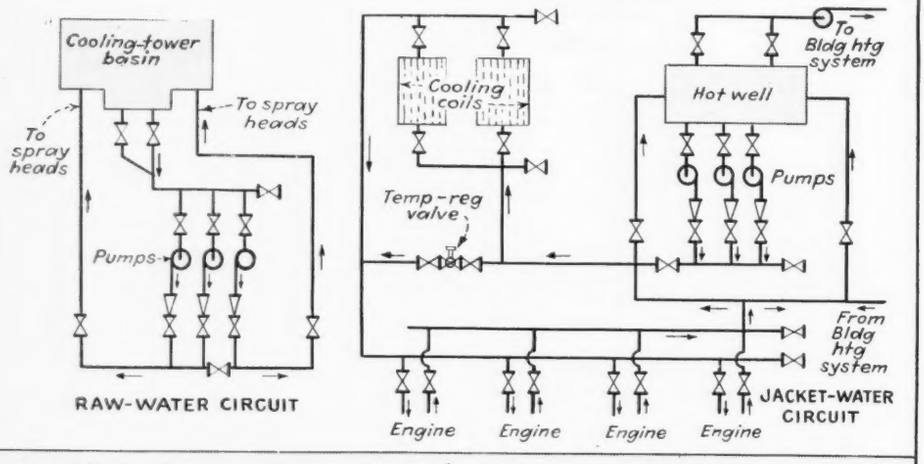
Transformers supplying station auxiliary power are located in the basement directly underneath the switchgear; the 120-volt station battery is in an adjoining room. This battery, in addition to powering switchgear and controls, supplies an emergency lighting system which goes into operation automatically if the station-lighting transformer fails.

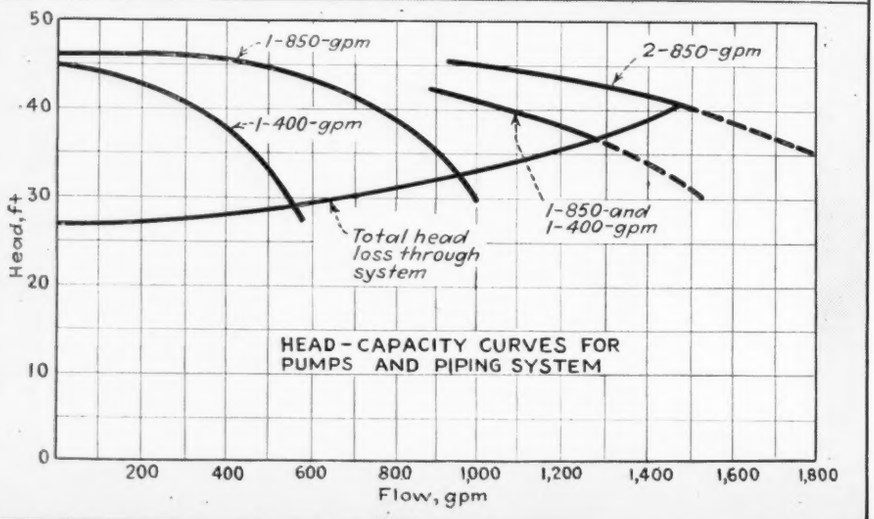




Engine-generators will include the new 1500-hp unit and three others to be moved from the old plant. The new engine, a 4-stroke-cycle, 6-cyl, mechanical-injection unit operating at 225 rpm, connects directly to a 1054-kw General Electric alternator with a silent-chain-driven 20-kw exciter. Pistons in the 23x28-in. cylinders are oil cooled. Curves above show exhaust temperatures and fuel rates recorded on test and indicate better-than-guarantee performance.

Pressure drop through the air filter and engine air-intake piping averaged 5-in. of water during the test. One engine-driven and one motor-driven Quincy air compressor take care of starting requirements of the 1500-hp unit.





The cooling system employs an induced-draft tower having a capacity of 10 million Btu per hr at a wet-bulb temperature of 76 F, cooling jacket water from 130 to 115 F. Zeolite-treated water for the jacket circuit flows through cooling coils in the tower base.

The cooling-tower basin was designed as two independent basins joined together, each section being provided with its own suction well. Two headers discharge water to the spray heads. Either half of the tower can be shut down for inspection and maintenance. Dividing the cooling coils in the tower prevents trouble in either half from shutting down the entire system.

As the diagram shows, this division of the cooling-water system is carried out in both raw- and jacket-water circuits. The duplicate layout permits shutting down either half of the piping for inspection and repairs. This arrangement will also take care of additional cooling capacity as needed, without rebuilding the existing system.

Extensive hydraulic calculations on both raw- and jacket-water systems insured facilities that would function correctly for the initial installation and sufficient reserve capacity for the fu-

ture. Pumps having head-capacity characteristics that would fit the head-capacity characteristics of the piping systems on both raw- and jacket-water sides were selected.

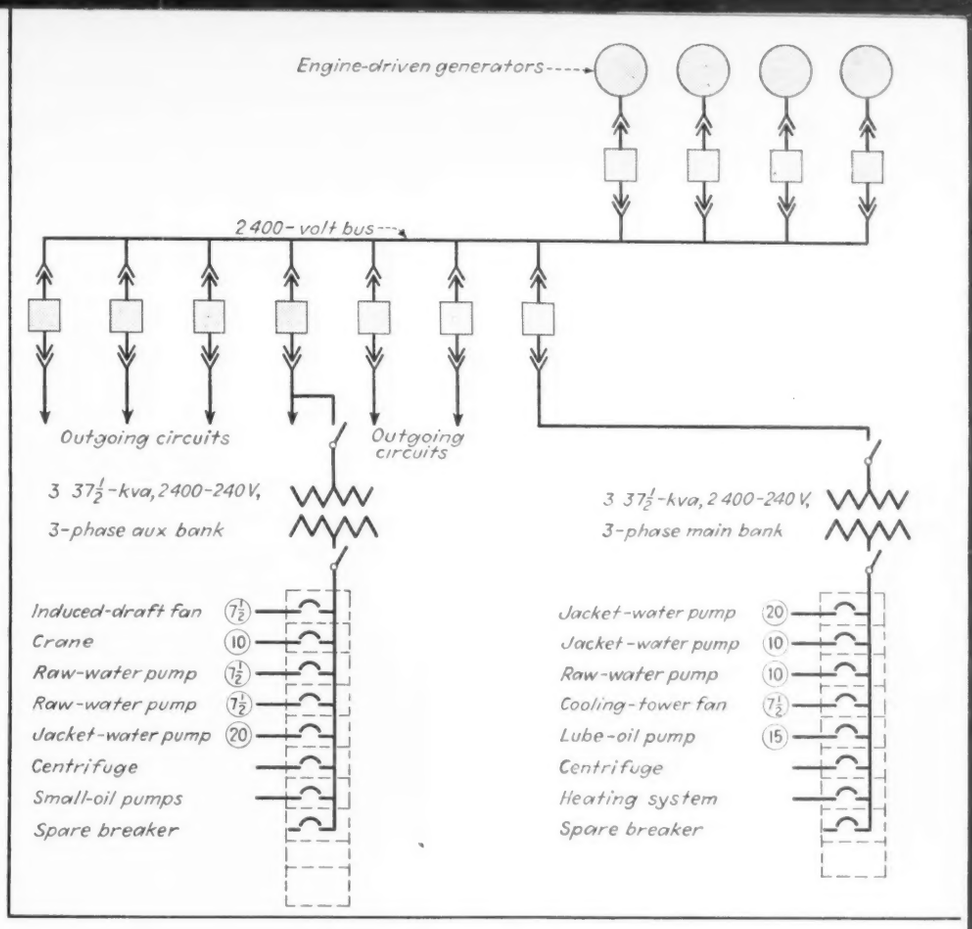
One 450-gpm and two 825-gpm Ingersoll-Rand pumps were installed on the jacket-water circuit. These ratings are for 65-ft head; all three pumps have shut-off heads of 82 ft. On the raw-water side, one 400-gpm and two 840-gpm pumps were chosen, operating at 35-ft head with a shut-off head of 45 ft. All are end-suction units.

The curves at the left show that the head-capacity characteristics of the pumps permit cooling 3200 hp of engine capacity at full load using one small and one large pump. This is practically the capacity of the cooling towers now installed. Provision for additional raw- and soft-water pumps, along with more cooling-tower capacity, will take care of anticipated future requirements.

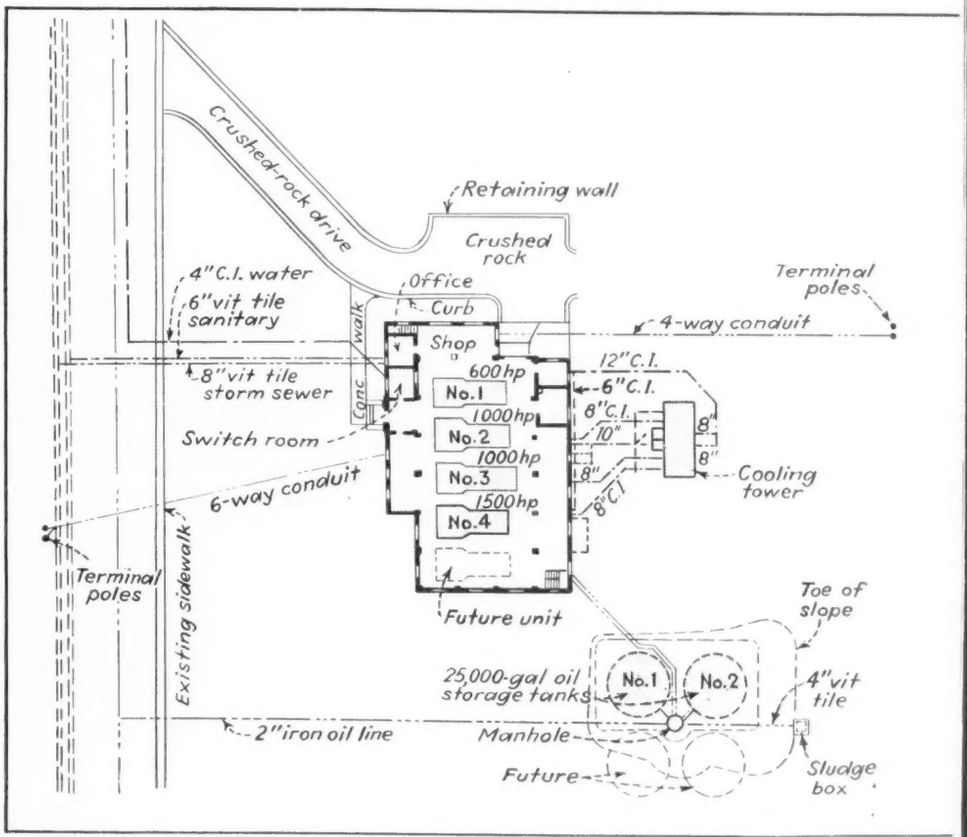
Building heating, under normal operating conditions, will be supplied from engine-jacket heat. Jacket water, maintained at a constant outlet temperature of 130 F by means of an automatic valve and bypass around the cooling coils, will be pumped through a series of 8 unit heaters. If jacket heat proves insufficient in severe weather, an auxiliary boiler will supplement the waste heat. The auxiliary boiler will also heat the building during the coming winter, as it is anticipated that all of the engine equipment will not be installed in the new building by that time and it will be necessary to supply heat when the 1500-hp unit is out of service.

Two of the unit heaters are installed in the superintendent's office and in the operators' office. These unit heaters, in addition to being connected to the jacket-water system for winter heating, are also connected to the city-water supply (from wells at 55 F) for summer air conditioning. Valve layout precludes the possibility of getting untreated city water in the engine jacket system.

Fuel-oil storage facilities for the plant include two 25,000-gal underground reinforced-concrete tanks. Space has been provided for two additional tanks of the same size. All oil piping terminates in a manhole near the tanks. An existing fuel-unloading rack and oil pump on a railroad spur approximately 1000 ft from the plant supplied the old station. Tapping this oil line and installing a branch to the new tanks permits oil to be pumped from tank cars to either plant as required.



Switchgear for control of 2400-volt power is metalclad, and consists of a synchronizing panel, four generator, one totalizing and seven feeder sections. Oil circuit breakers have interrupting capacities of 50,000 kva each and a one-second current-carrying capacity of 20,000 amp. All breakers are electrically operated, and are removable from the rear of the cubicles. Space behind allows for inspection and maintenance of any breaker. All, both generator and feeder units, are interchangeable, and only a few minutes is required to remove a breaker from service and substitute another for it.



Three Ways To Support a Condenser

Rigid mounting, springing or hanging from the turbine can be used, depending on condenser-basement conditions. A J Braun, Allis-Chalmers Mfg Co, describes some ways of providing flexibility

▶ BECAUSE A CONDENSER is attached to a turbine by a relatively large and rigid exhaust neck, any movement of either must be taken up by the design of the condenser mounting. Too much condenser weight pulling down on the turbine tends to distort the exhaust casing; condenser motion due to temperature expansion can set up high stresses in circulating and condensate piping.

Any one of three methods illustrated here can be applied to a given installation, if the design is properly carried out and suited to the over-all layout. Turbine size and design as well as exhaust-nozzle shape and allowable loading are important factors. The decision may rest, however, on other conditions such as basement depth, foundation construction, parallel or crosswise setting of the condenser in relation to the turbine, offset nozzle or side steam-inlet necessitated by space limitations or turbine design. Often any one of the three methods could apply and the selection becomes a matter of costs.

Flexible Connection

For small, medium and even some large condensers, the shell is rigidly anchored to a foundation, Fig. 1, and a flexible connection between the steam inlet and turbine exhaust-nozzle takes up all thermal-expansion movement. This method can be adapted to a wide range of conditions, since the condenser can be offset sidewise or lengthwise in either direction without placing unbalanced loading on the turbine exhaust. This mounting is particularly well suited to side-exhaust turbines or other unsymmetrical layouts.

The flexible connection must be carefully designed to care for movement in any direction, must remain perfectly tight, and must be able to withstand the pressure-difference due to high vacuum. Welded-steel construction is preferable, and it eliminates one bolted flange joint, reducing the number of potential air leaks.

Rigid attachment of the condenser to the exhaust flange of the turbine, Fig. 2, results in the full condenser weight being supported by the turbine and is, therefore, limited to smaller units. An

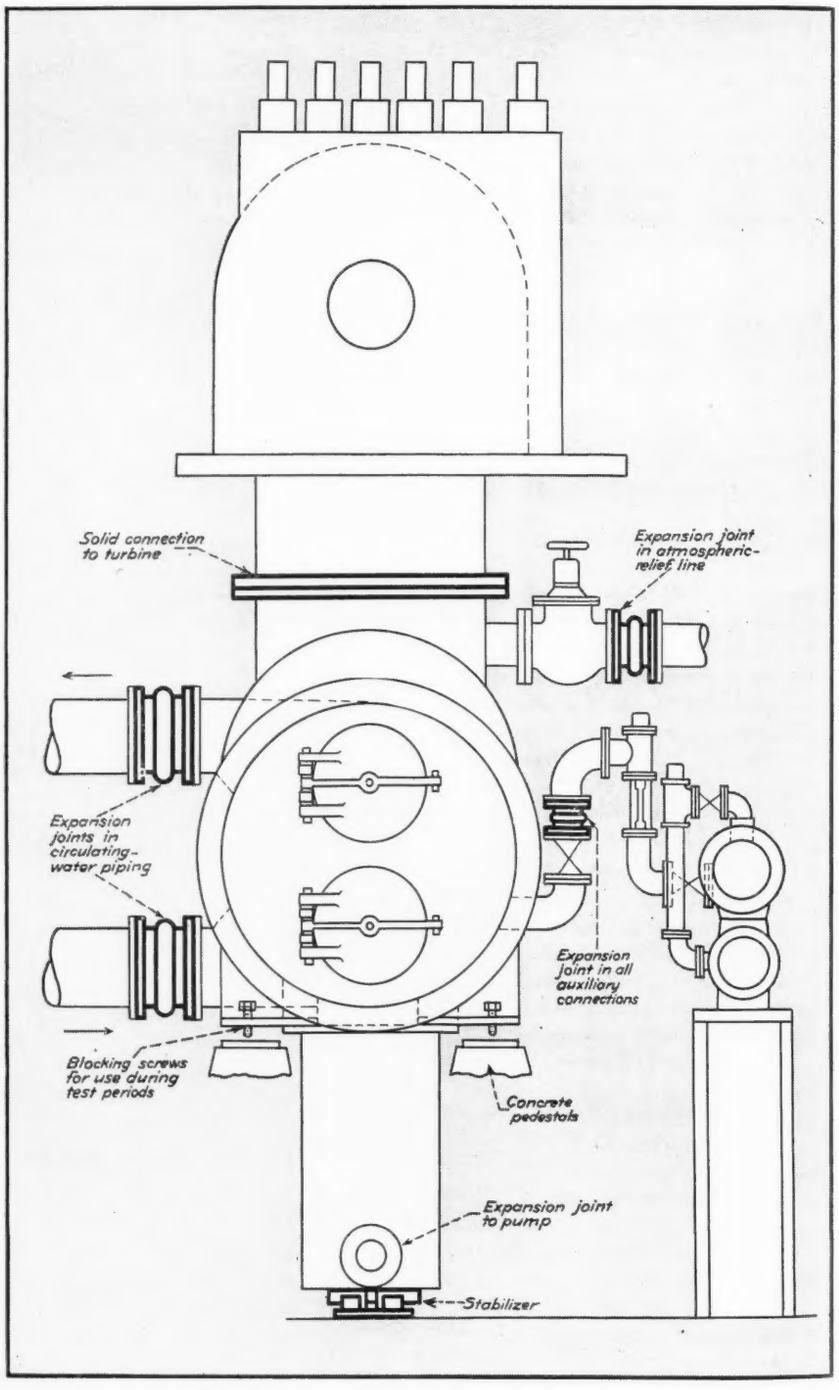

Solid connection to turbine
Expansion joint in atmospheric-relief line
Expansion joints in circulating-water piping
Expansion joint in all auxiliary connections
Blocking screws for use during test periods
Concrete pedestals
Expansion joint to pump
Stabilizer

Fig. 2—Condenser can be hung directly from turbine exhaust if all piping is provided with expansion joints and lateral motion is prevented by a stabilizer

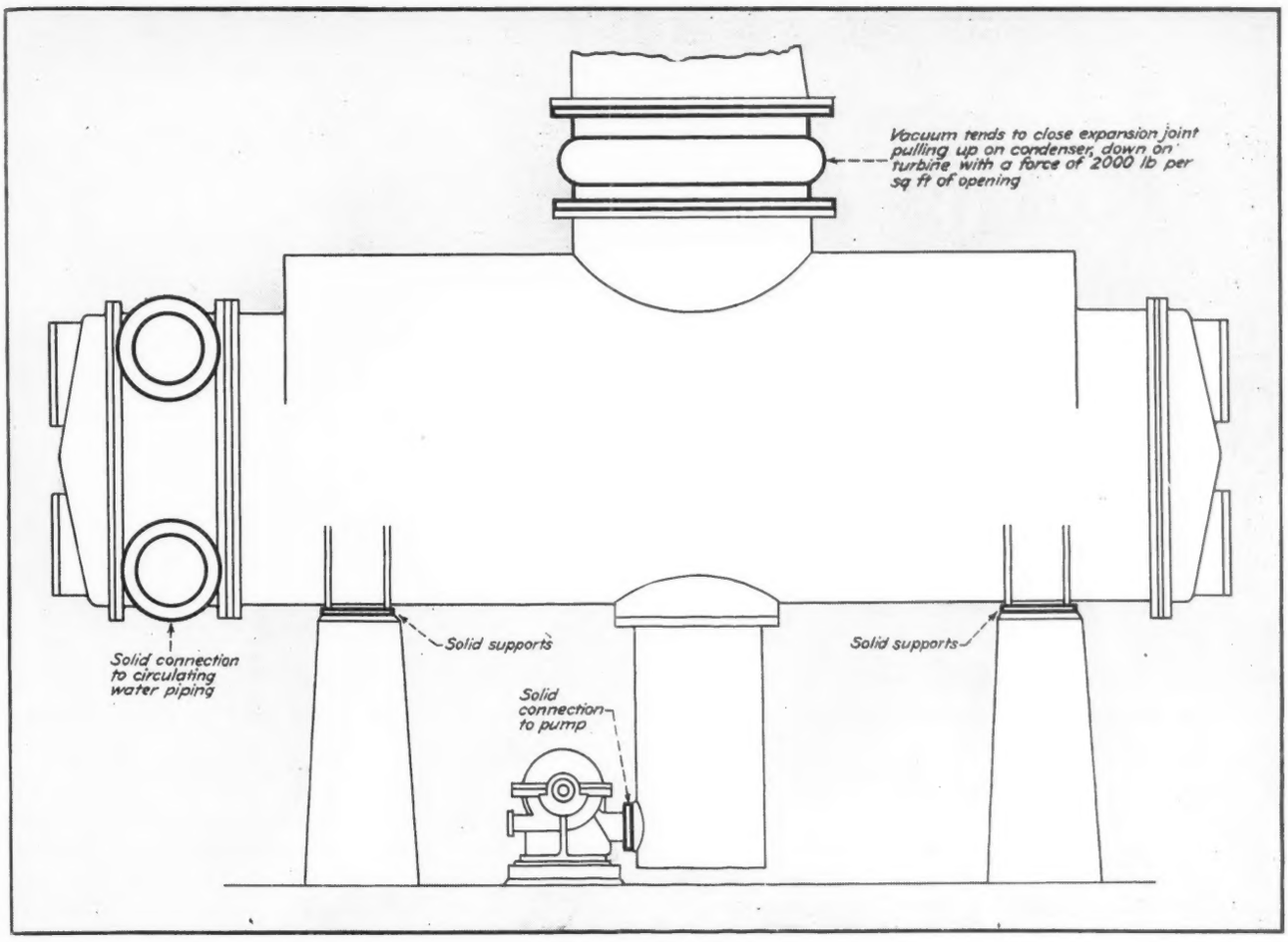

Vacuum tends to close expansion joint pulling up on condenser, down on turbine with a force of 2000 lb per sq ft of opening
Solid supports
Solid supports
Solid connection to circulating water piping
Solid connection to pump

Fig. 1—Flexible exhaust connection with rigid foundation-supports requires no expansion joints in connecting piping to circulators, condensate pumps and ejectors

expansion joint must connect each pipe to the shell or water boxes.

To prevent unbalanced loading with the "hung" mounting, the condenser is designed so that the steam-inlet nozzle is directly above the center of gravity of the entire condenser assembly when the tubes and water spaces are filled with water. For periods of unbalanced loading, that is, when the steam space is filled with water for a leakage test, blocking screws on the feet transfer the load from the exhaust nozzle to the foundations. The screws must be backed off, however, before placing the turbine in operation, to permit free movement as various parts of the assembly rise to running temperature.

Stabilizers

Hanging a condenser presents a problem of overcoming vibration and reaction caused by change in direction of circulating-water flow. Stabilizers allow free up-and-down motion but restrict sidewise play. These devices consist of ribs or blocks welded to the under side of the hotwell which butt against similar ribs or blocks welded to a plate grouted and bolted in the basement floor.

Unless conditions are particularly well suited to a hung condenser, the

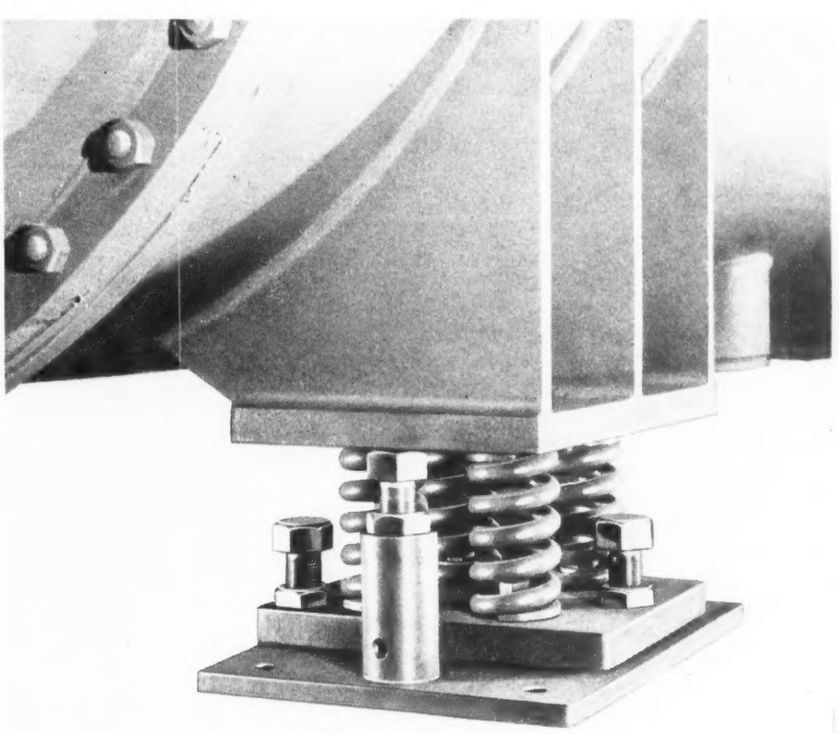


Fig. 4—Leveling screws adjust lower plate of nested springs to equalize load. Blocking jacks take load off springs when steam space is filled with water

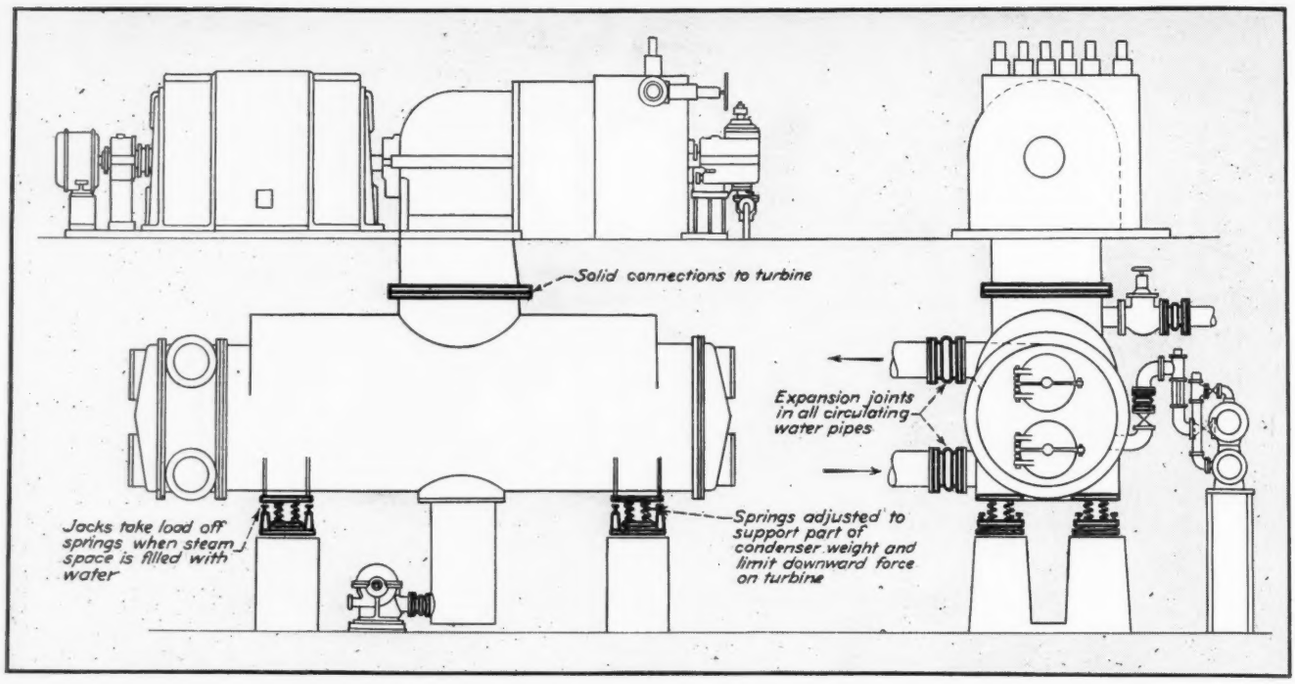

Solid connections to turbine
Expansion joints in all circulating water pipes
Springs adjusted to support part of condenser weight and limit downward force on turbine
Jacks take load off springs when steam space is filled with water

Fig. 3—Rigid connection to turbine exhaust, with spring supports to take part of the weight, is preferred for large condensers

flexible connection of Fig. 1 is preferred. Cost of the several smaller expansion joints between condenser and piping, Fig. 2, offsets cost of the large expansion joint, Fig. 1.

In mounting a condenser on spring supports, Fig. 3, the steam-inlet nozzle connects rigidly to the turbine exhaust casing. The condenser moves to suit temperature expansion and the springs keep the loading on the turbine flange within turbine-design limits. Used on most medium and large condensers, this method particularly suits rectangular or otherwise odd-shaped turbine exhaust nozzles. The latter are difficult to adjust to the flexible connection at the turbine exhaust shown in Fig. 1.

Spring Arrangement

Selection of number, type and size of springs depends on condenser and water weight, and the amount of expansion-movement expected, as well as the turbine manufacturer's loading limit on the exhaust casing. Spring design accommodates unbalanced loading so that there is no tendency to twist the turbine exhaust. With spring supports, however, piping connections to the shell and water boxes must all have expansion joints, as with a hung mounting.

Each spring assembly has suitable jacks for use during erection and during later periods when the steam space is filled with water. Fig. 4 shows a typical assembly with a nest of four springs set between the condenser foot and a leveling plate. The stress in each spring is adjusted by the leveling screws which butt against a steel base plate mounted in the foundation pier. Screw jacks carry the added weight of water during erection and test.

Fig. 5 shows the type spring support used on large size condenser installations. This spring nest is equipped with a hydraulic jack as well as a set of blocking screws. The hydraulic jack is used to adjust the springs and the blocking jacks take the load during erection and during periods when the steam spaces are filled with water for leakage test.

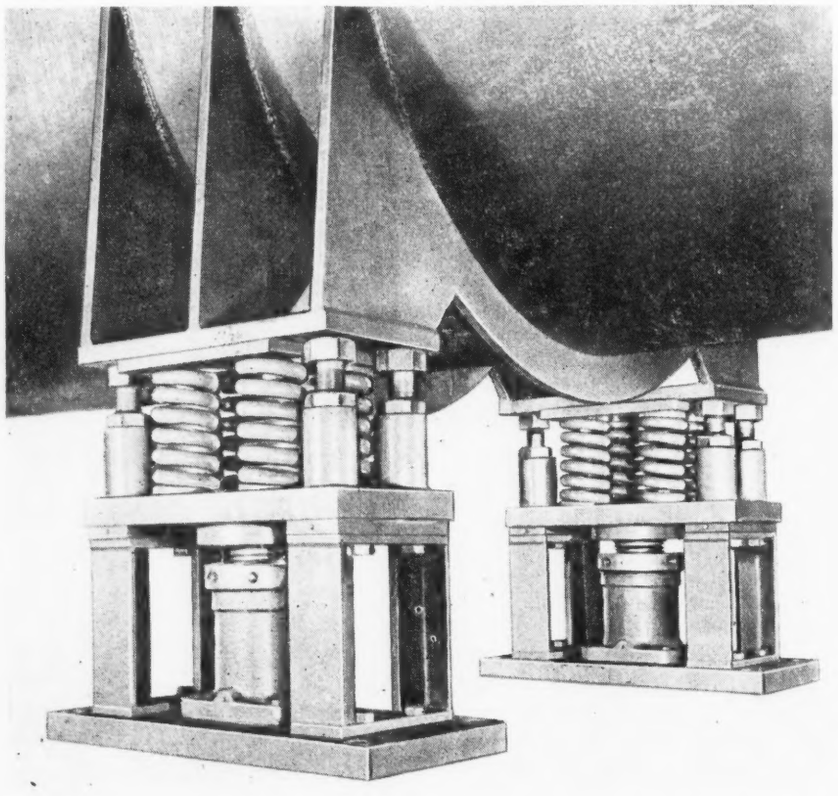


Fig. 5—Spring supports are sometimes equipped with hydraulic jacks for load adjustment as well as blocking jacks for taking added weight during leakage test

Power-Factor Improvement With Capacitors—II

M I Alimansky, electrical engineer, General Electric Co, told in the October number how to use capacitors to reduce power system loads; here he completes the story and shows how to select the right size of unit for power-factor improvement

► CAPACITOR RATING required to improve lagging power factor depends upon the size of the load in kilowatts, its power factor and the amount of improvement required. Usually it is not economical to improve the power factor of a power system, feeder or motor above 0.90 or 0.95. Capacitors may be applied directly to motor terminals, on the load end of individual feeders at load centers, on the supply end of individual feeders, on the low-voltage busbars or on the high-voltage feeder at the step-down transformer bank.

Before we can calculate the capacitor capacity necessary to improve full-load power factor of a motor a given amount, we must know the full-load power-factor and efficiency of the motor. Figs. 3 and 4 have been prepared as a guide in estimating the power-factor and efficiency of the average squirrel-cage motor, regardless of manufacture. They are sufficiently accurate for use in calculating the rating of a capacitor to be connected across the motor terminals, since standard capacitors are built in standard units.

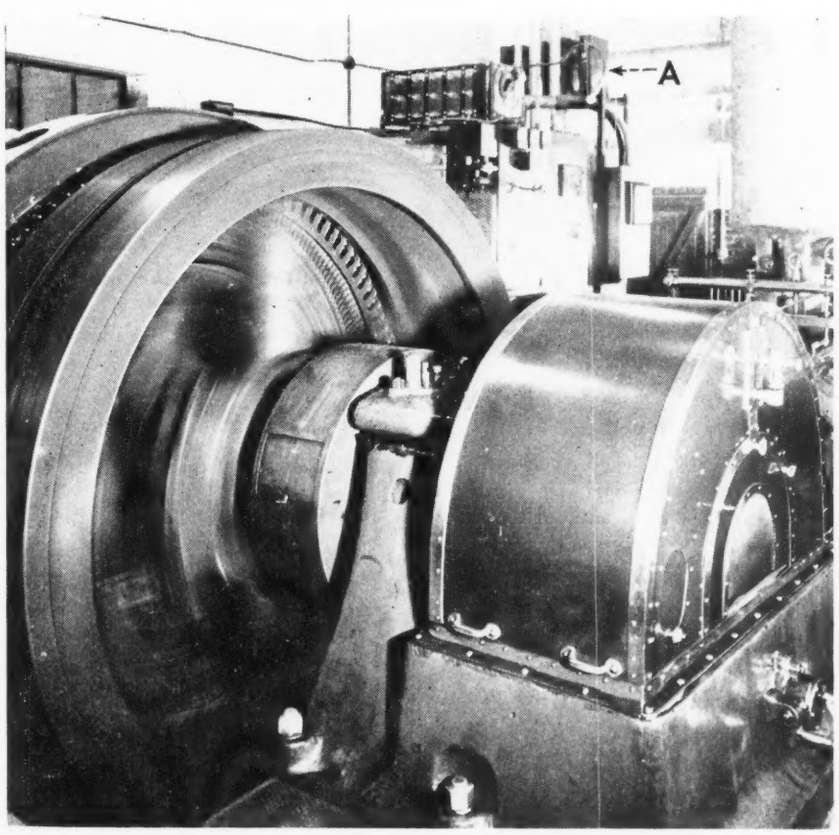


Fig. 1—The 120-kva capacitor installed at *A* improves the power factor from 0.65 to 0.83 and permits this 300-kw generator to carry the load without overheating

It is necessary to know the efficiency and power-factor at full load only, since the power-factor of a typical motor with a capacitor connected across its terminals remains practically constant except at light loads. This is because the magnetizing current of the motor remains nearly constant and it is the lagging effect of the magnetizing current that the capacitor must counteract. Load on any ac circuit may be divided into a power component and a magnetizing or reactive component at right angles to each other as shown in Fig. 2. The explanation for this requires a rather complicated mathematical process which need not concern us, for

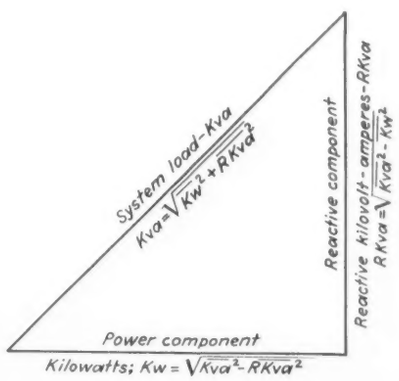


Fig. 2—An alternating-current load in kilovolt-amperes may be divided into a power component, kilowatts, and a reactive part, reactive kilovolt-amperes

the solution of power-factor problems involves nothing more than the calculations of the sides of a right triangle. All a capacitor does is to absorb part or all of the reactive component. If the capacitor rating equals the reactive component then the power factor becomes unity and the system kva load equals the kilowatt load, which is the ideal condition.

Assume we wished to calculate the capacitor rating necessary to improve the power factor of a 10-hp, 900-rpm squirrel-cage motor. Fig. 3 gives the full-load efficiency of this motor as 84.5%. Power input to the motor, $Kw = (Hp \times 0.746) \div efficiency = 10 \times 0.746 \div 0.855 = 8.73$. Fig. 4 gives the power factor of a 10-hp, 900-rpm

squirrel-cage motor as 0.793. The kilovolt-ampere input to the motor, *kva* = *kilowatts* ÷ *power factor* = 8.73 ÷ 0.793 = 11 kva taken from the line.

On our load diagram, Fig. 2, we now know the power component, *Kw* = 8.73 and the load *Kva* = 11, then the reactive component *Rkva* = $\sqrt{Kva^2 - Kw^2} = \sqrt{(11x11) - (8.73x8.73)} = 6.7$ kva. If we were going to improve the power factor to unity it would be necessary to install a capacitor with a rating equal to the reactive component of the load, or 6.7 kva. However, as previously mentioned, it is seldom economical to do this. Therefore let us assume an improvement to 0.95.

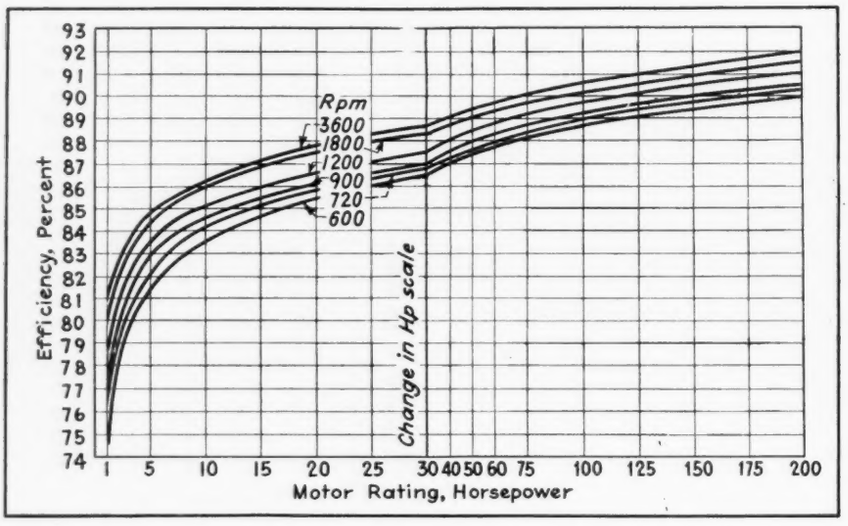


Fig. 3—Approximate full-load efficiencies of squirrel-cage induction motors

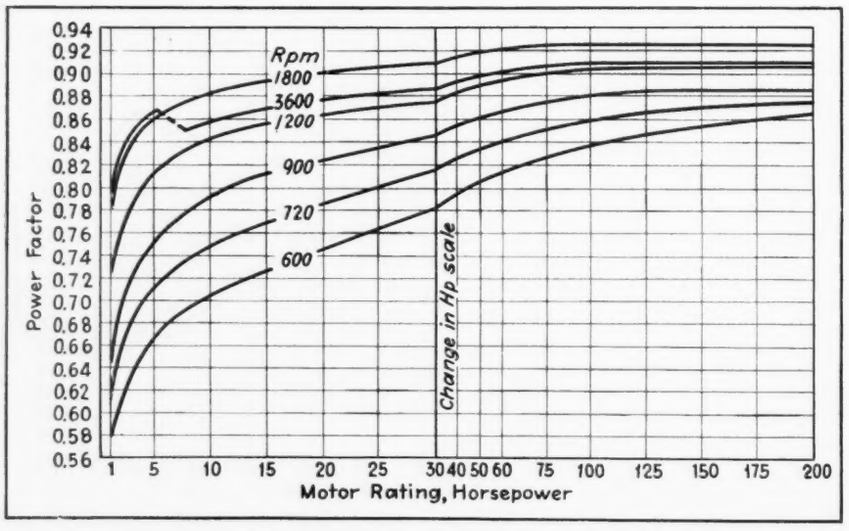


Fig. 4—Approximate full-load power factors of squirrel-cage induction motors

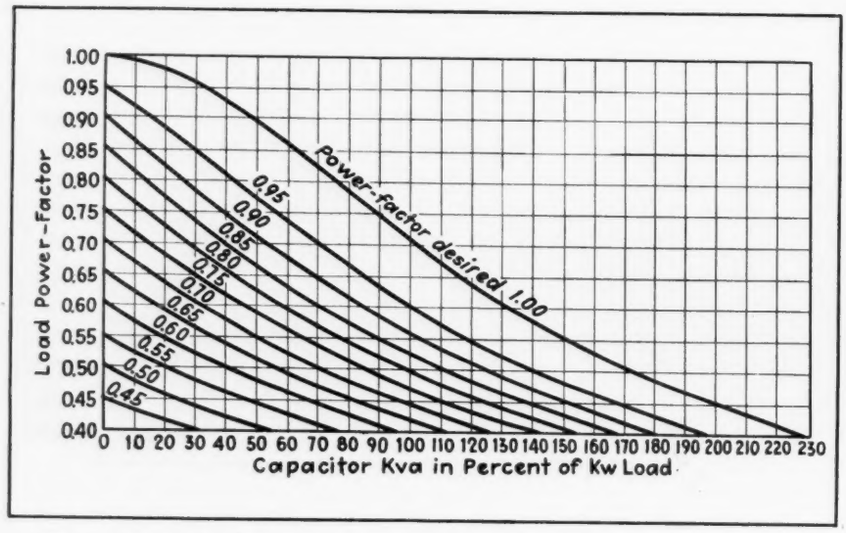


Fig. 5—Curves for determining the size of capacitors to improve power-factor

For improvement of power factor to other than unity, first determine the leading kva required to correct the power factor to unity, which we have done. Then, calculate the reactive kva at the desired power factor, in our case 0.95 at the motor load of 8.73 kw. At a power factor of 0.95 the load *kva* = *Kw* ÷ *Pf* = 8.73 ÷ 0.95 = 9.19. The reactive component, *Rkva* = $\sqrt{Kva^2 - Kw^2} = \sqrt{(9.19x9.19) - (8.73x8.73} = 2.9$ kva. The difference between 6.7 kva capacitor rating required to improve the power factor to unity and 2.9 kva reactive component at 0.95 power factor is 6.7 — 2.9 = 3.8 kva. That is, if we connect a capacitor rated at 3.8 kva across the motor terminals, the power factor of the combination will be 0.95.

Economic Power Factor

This problem shows why it is not generally economical to correct the power factor to unity. It requires only 3.8 kva capacitor capacity to improve the power factor from 79.3 to 95 or 16 points. To improve the power factor the other 5 points, 0.95 to unity, requires 2.9 kva, almost as much as required for the first 16 points. That is, it would cost almost as much to improve the power factor from 0.95 to unity as it would from 0.79 to 0.95, but the improvement is worth only one-third as much.

When calculating capacitor sizes to improve the power factor of a group of motors to some desired value, such as 0.90, the size of the capacitors to be connected across each motor can be determined separately as previously shown. It is generally more economical, however, to install a single capacitor unit on the line that supplies the group, because it is likely that all the motors will not be used at one time. Also, one large capacitor unit will have a lower initial and installation cost than will a group of small ones having the same combined rating.

When dealing with a group of motors on a feeder, first determine with meters the maximum load on the feeder and its power factor. Assume that a 300-kw load at 0.60 power factor is to be improved to 0.90. The

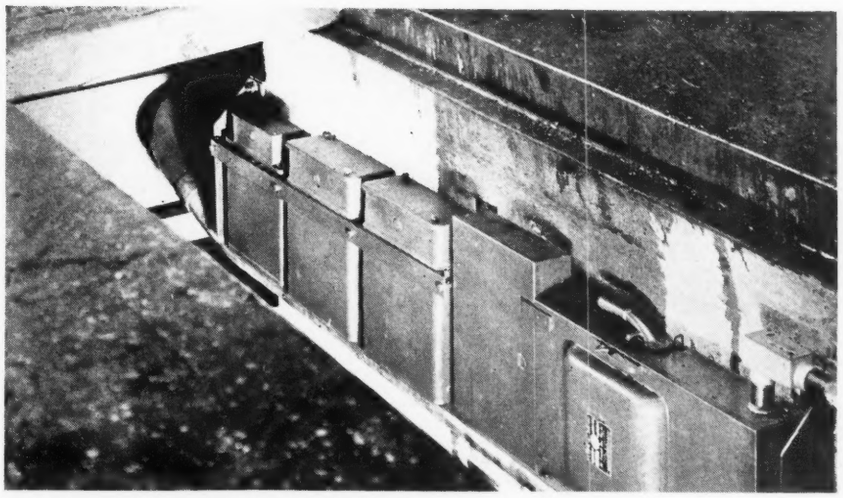


Fig. 6—Two 15-kva and a 10-kva capacitor with rack and fusable switches installed below the floor of a large automobile-body plant

load $Kva = Kw \div Pf = 300 \div 0.60 = 500$ and the lagging reactive component $Rkva = \sqrt{Kva^2 - Kw^2} = \sqrt{(500x500) - (300x300)} = 400$ kva. To correct the power factor to unity we would have to install capacitors having a rating of 400 kva.

At 0.90 power factor the load $Kva = Kw \div Pf = 300 \div 0.90 = 333$ and the reactive component $Rkva = \sqrt{333^2 - 300^2} = 145$ kva. The difference between the two reactive components is 400 — 145 = 255 kva, the capacitor capacity that must be installed to raise the power factor from 0.60 to 0.90. Adding this capacitor will reduce the load on the system from 500 to 333 kva or to within 33 kva of the kilowatt load.

Here again we see why it is not generally economical to improve the power factor to unity. By installing a 255-kva capacitor we can reduce the load from 500 to 333 kva, a reduction of 167 kva. To raise the power factor to unity would require a 145-kva additional capacitor capacity, but it would only reduce the load 33 kva.

The capacitor may be installed at either the load end of the feeder or at the power-house or substation end. If installed at the load end the power factor will be improved on the feeder and its load reduced, as well as on the equipment supplying the power. For this reason capacitors are usually installed on the load end of feeders. If they are installed at the supply end, power factor is improved from the busbars back to the system and the feeder load is not reduced or its voltage improved.

Sometimes it is advisable to install the capacitor on the power-house or substation busbars, in which case the load and power factor is determined by meters and the capacitor size calculated as previously explained for a single feeder.

The curves, Fig. 5, simplify power-factor-improvement calculations when using capacitors. For example, take the previous problem of 300 kw at 0.60 power factor, to be improved to 0.90. To solve this problem, find power factor 0.60 on the left-hand side of the chart and project horizontally to the

(*Continued on page* 140)

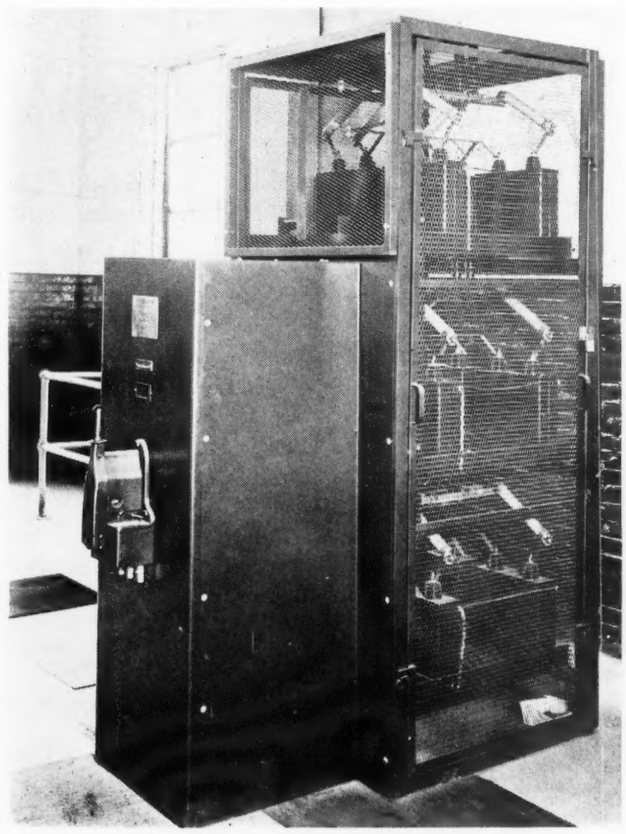


Fig. 7—Indoor 225-kva, 2300-volt, rack-type capacitor installed in plant of a municipal power system

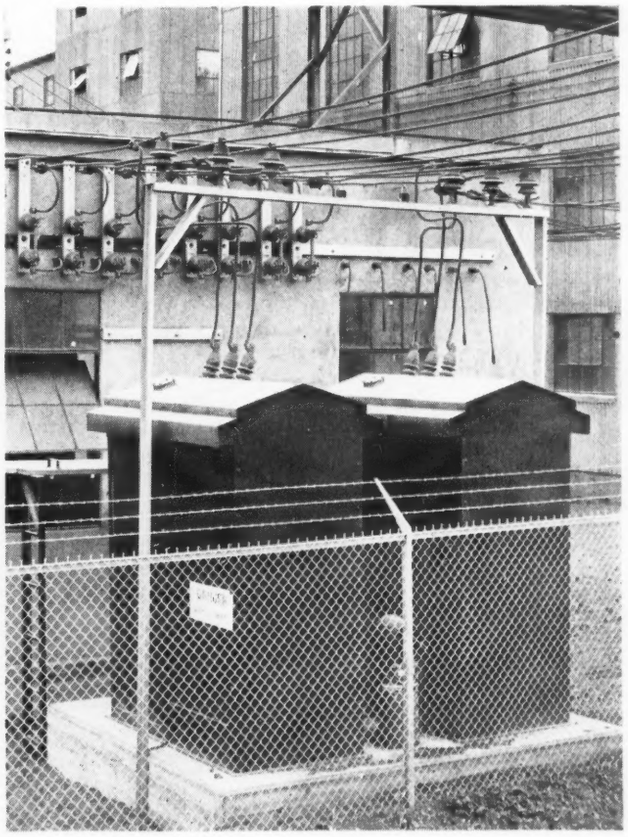


Fig. 8—Two outdoor 360-kva, 2300-volt rack-type capacitors installed outside a manufacturing plant

Fig. 1—New section of simplified-masonry building houses 76,500 kw as compared to original 1925 construction rated at 80,000 kw

Twin Branch Leads The Way With 2500-lb Operation

In operation since March, 550,000-lb-per-hr natural-circulation boiler, high- and low-pressure turbines totalling 76,500 kw have already established 72% availability. Operating results for 600 hours show better than 10,300 Btu per kwhr

▶ TWIN BRANCH, 80,000-kw plant of the American Gas & Electric Co (Indiana & Michigan Electric Co) near South Bend, Ind., was selected for expansion because of load increase in its surrounding territory. Choice of 2500-lb operating pressure was made because high coal-cost helped justify a natural inclination to improve the efficiency of steam-generated power.

The original plan, followed out in principle, called for a single boiler supplying a cross-compound turbine arrangement with initial temperature of about 940 F and flue-gas reheat to 900 F before the low-pressure unit. The new unit normally operates as a condensing machine, entirely separate from the existing plant except for a connection which allows low-pressure-turbine operation on steam from the older boilers and an accompanying condensate return arrangement.

The Babcock & Wilcox open-pass natural-circulation boiler, rated at 550,000 lb per hr, differs from the conventional open-pass design in that side walls of the first and second passes are covered with reheat surface, and the second pass contains radiant-convection superheater elements. The division wall between first and second pass is steam-generating surface; division wall between second and last pass is reheat surface.

The last boiler pass contains initial superheater, reheat and economizer surfaces. The reheater is apart from the superheater and controlled by baffles and bypass damper. Superheat is regulated by an attemperator, consisting of a 5-spray desuperheater, between convection and radiant superheaters.

Eight vertical intertube burners are supplied from four Type E pulverizers. Oil burners for ignition can fire enough No. 3 oil to make 50,000 lb of steam per hr each. Dump-type automatic scales weigh coal to each mill and feed lines are equipped with sight glasses, as well as "no flow" alarms.

Primary and secondary air flows through separate sections of the air preheater. Dampers on the gas side, controlled from the boiler panel, hold primary-air temperature to 390 F; secondary air ranges from 520 to 570 F.

The induced-draft fans, 17.8-in. static pressure, are provided with a special arrangement of inlet boxes and vanes for flyash elimination before flue gas enters the fan wheel. Flyash, with part of the gas, is carried to a secondary collector for disposal.

Continuous slag-tap from the primary furnace is hydraulically moved to a receiving pit outside. The secondary ash pit at the bottom of the second pass is designed for either dry or wet storage. Conventional soot blowers are installed

Editor's Note: *Condensed from eight articles in Electrical World, Oct. 17, 1941.*

in the convection pass and air heater. Telescopic units are in trial use in the second pass.

The effectiveness of natural circulation has been proved by pitot-tube measurements in all generating circuits of the boiler. These tests indicate greater-than-calculated flows at all points in boiler and water-wall tubes.

During the starting-up period, the boiler was completely filled with water treated with sodium sulphite and heated to 200 F before the fire was lighted. After dropping water level, a mixture of Calgonite and caustic soda was added and the pressure brought up to 75 lb in 18 hr. Intermittent blowdown then reduced solids concentration from 10,000 to 5000 ppm. Over a period of 20 hr, pressure was increased to 275 lb and maintained for five hr; during this time steam was vented and continuous blowdown reduced solids to 500 ppm.

After superheater and steam lines were blown to atmosphere, boiler surfaces were free of oil and other matter. Normal routine for starting requires that temperature-differences along the drum be kept within 50 F as indicated by thermocouples and recorded on the operator's control panel. Heating the filled boiler to 200 F by steam from the old section of the plant keeps drum temperature differences within the 50-F limit allowed by internal drum stress.

After the oil burners are placed in service and drum-level lowered, steam from the old section of the plant is circulated through reheater sections to prevent overheating. Flow to the turbines is established at about 400-lb pressure and oil firing is continued until the unit is on the line.

Boiler-Water Treatment

In operation, chemicals are fed directly to the boiler through the two main downcomers by a high-pressure feed-bottle bridged across the economizer. Blowdown connection is in the center of the lower drum and boiler-water sampling is done from this point.

Continuous steam samples are taken from tubes between drum and superheater, at the outlets of primary superheater and secondary superheater. Insulated stainless-steel throttling tubes regulate flow to 75-110 lb per hr and conductivity measurements are recorded by a Leeds & Northrup instrument. Feedwater is also sampled continuously from the economizer discharge. Provision is made to deliver the saturated steam sample to a Cambridge hydrogen recorder for determination of any difference in hydrogen content indicative of oxidation of boiler metal.

The 3600-rpm high-pressure turbine is a General Electric double-shell unit in which an inner shell with its own bolting flange encloses the high-pressure stages. Maximum pressure in the space between inner and outer shells at full load is 955 lb. First-stage buckets are 0.75-in. long and steam is admitted around 287 degrees of arc. The 1800-rpm low-pressure unit is a typical single-flow machine except that the high-pressure casing is of alloy steel to accommodate 900-F reheat temperature. No control valves are required and steam is admitted to the full arc of the first stage at all loads. Increasing pressure to 2300 lb at the turbine with reheat gives a large heat drop (720 Btu) per lb and results in greater extraction for feedheating (34% at Twin Branch). Thus for a given kw output, fewer lb of steam enter the throttle and a smaller percentage of throttle steam

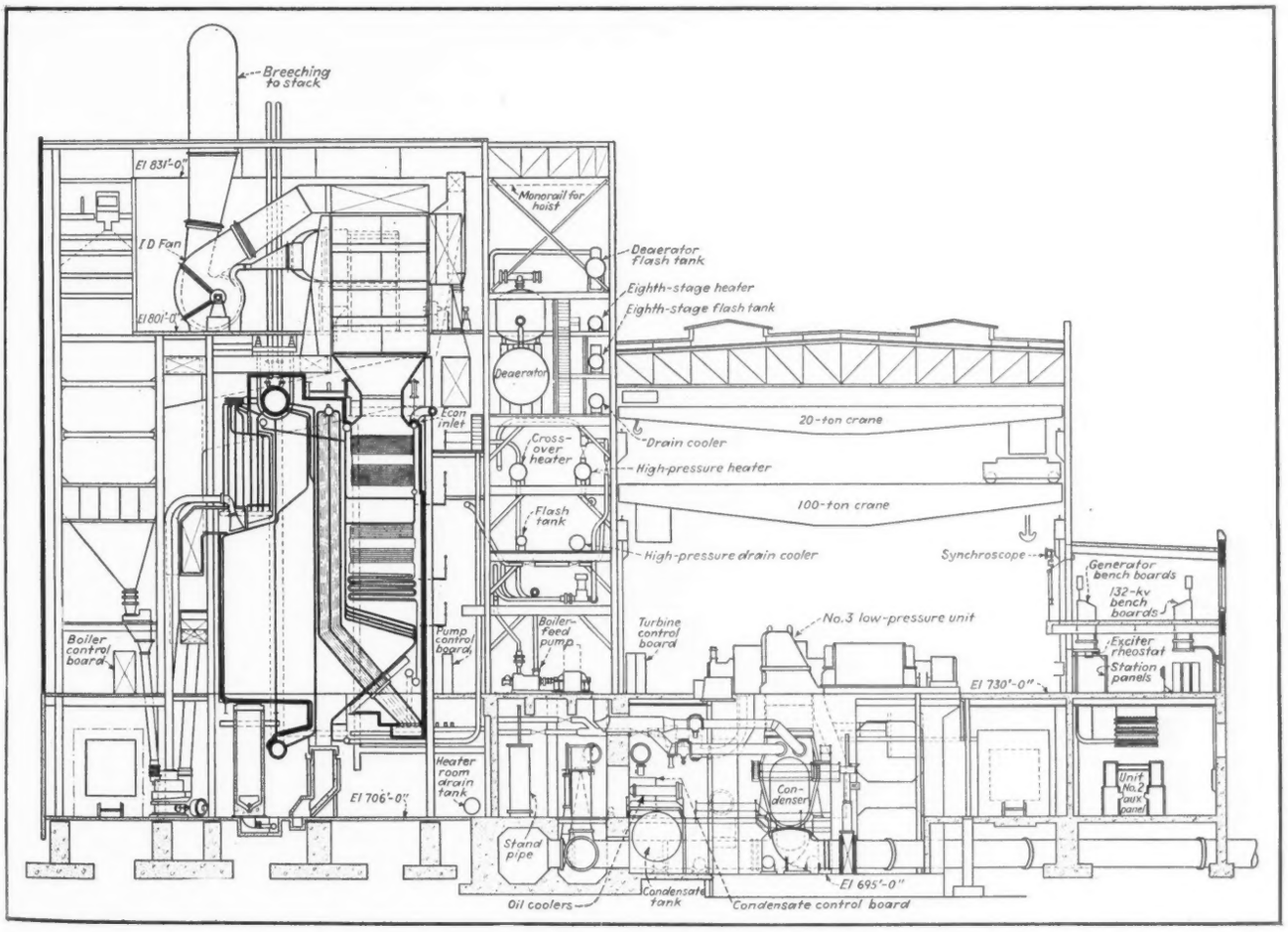


Fig. 2—Single open-pass natural-circulation boiler supplies 2500-lb 940-F steam to 22,500-kw 3600-rpm h-p turbine, then reheats to 900 F for 55,000-kw 1800-rpm l-p unit. Note compact arrrangement which accounts for space use of only 25 cu ft per kw

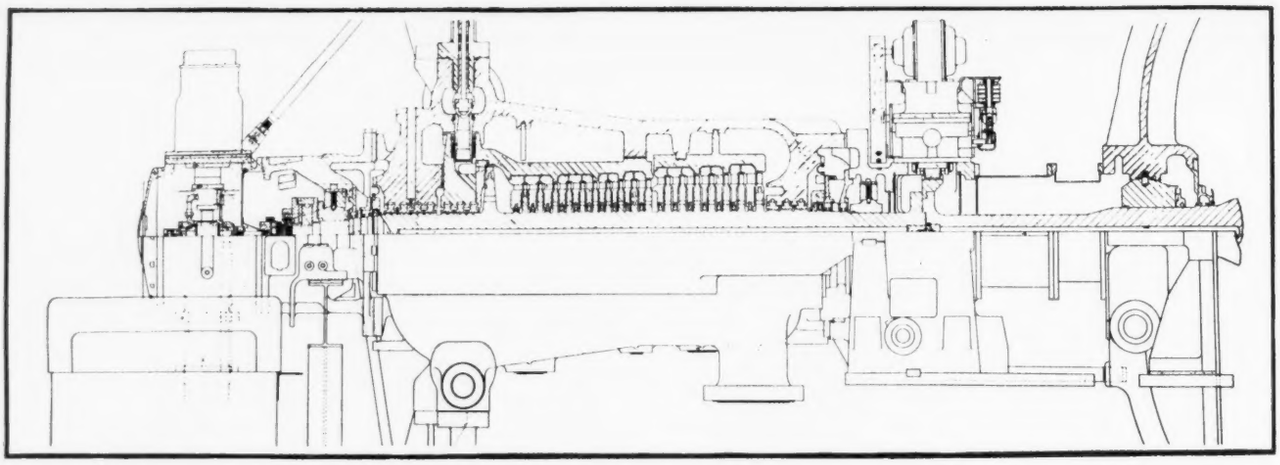


Fig. 3—High-pressure double-shell 3600-rpm turbine with 11th-stage extraction between two parts of inner shell and 14th-stage extraction through holes in chamber between inner and outer shells. Low-pressure turbine is essentially stock design with alloy-steel casing

gets to the condenser. This condition allows building a smaller last stage of the low-pressure turbine and a smaller condenser than would be indicated by the kw rating.

In addition, reheat to 900 F improves the wheel efficiency of the low-pressure turbine by maintaining superheated conditions through the first two-thirds of the machine. Moisture content in the exhaust never exceeds 6.5%.

The low-pressure turbine is arranged to operate on 600-lb 750-F steam from spare boiler capacity available in the station. An intercepting valve, required on all resuperheating turbines to prevent overspeed in case of loss of load, is utilized as a control valve for separate operation of the low-pressure element. A stop valve ahead of the intercepting valve allows changing the governor setting from a pre-emergency control to that of a speed-regulator to govern the machine as a single-valve turbine.

Both generators are hydrogen cooled at ½-lb pressure served by a single set of hydrogen-cooling auxiliaries. Electrical circuits are tied directly to the 132-kv bus through a transformer bank so that Unit No. 3, comprising both 22,500- and 54,000-kw elements, is electrically independent of the original installation. Separate operation of the elements can be achieved by opening disconnects in the 11-kv generator connections to the transformer bank.

Auxiliary power is taken from a separate winding on the main transformers supplemented by emergency supply from the existing station and Twin Branch hydro plant. Motor drives and controls were kept as simple as possible. Squirrel-cage induction motors were used throughout, except for two 800-hp tank-pump, wound-rotor drives for speed control.

Electrical fire hazards are met by a two-ton bulk-storage carbon-dioxide fire-extinguishing system to flood the auxiliary switchrooms. A comprehensive water-hydrant system to be used with portable foam-generators and spray nozzles is the backbone of the fire-fighting system.

Feedwater heating to about 470 F is accomplished in five stages, including a crossover heater and one extraction point on the high-pressure turbine. Because the low-pressure turbine was an available machine at time of purchase with the bleed belts already cast, the 14th-stage heater has a quite high rise. An extraction point at about 6-lb abs might have been preferable to the 11-lb point.

Generator Cooling

Hydrogen coolers use only condensate for nine months of the year, but are valved for river water in summer months. This saves investment cost for an added cooler bank and avoids a cleaning problem during most of the year. Condensate is also the only coolant for the steam-jet air pump inter- and after-condensers with not even a service-water starting section. During starting, condensate is recirculated back to the condenser, where it is cooled.

To obtain a maximum of 14th stage bleed, a gland-steam leakoff condenser was installed. The deaerator is in the usual position in the cycle, slightly above atmospheric pressure at all loads. Physically, the deaerator is high above the tank pumps to avoid flashing in the piping. The flow diagram shows no evaporators, as existing evaporator equipment has sufficient available capacity for the new unit.

The three forged-steel, barrel-type Ingersoll-Rand boiler-feed pumps are direct-connected to 2500-hp 3600-rpm motors. Each pump can carry full load on the unit. Because more wear and maintenance were expected on the pumps than on the motor drive, only two motors were bought and two sets of controls and cables installed. Either of the motors can be moved by hoists for connection to any of the pumps.

Normally one of two 600,000-lb-per-hr tank pumps is in service with one boiler-feed pump. The adjustable-speed 800-hp (wound-rotor) tank-pump drive is controlled to maintain about 200-lb pressure-drop across the feedwater regulating valve. The tank pumps have a discharge pressure close to the feed pumps of the existing 600-lb plant, giving the benefit of a secondary spare without cost.

Intermediate- and low-pressure heaters, furnished by Griscom-Russell Co, are straight-tube, floating-head, removable-bundle type with double-bolted waterbox closures. High-pressure Foster Wheeler Corp heaters employ the Lockhead type of waterbox closure and have Monel tubes for strength as well as corrosion resistance. The extraction heater has a desuperheat zone, while the crossover heater has none. Monel tubes were annealed at 1100 F to give a yield point of 45,000 psi and were tested at 6400 lb hydrostatic pressure.

For protection in event of tube leakage, high-pressure heater shells have relief valves. The drain system, while liberally designed, is quite limited in protecting the heater against excess pressure in case of tube failure. Normal drains are flashed in separate flash tanks or combined flash-and-drain tanks so that only steam passes into the heater shell, the condensate going directly to the hotwell. This avoids impingement of wet mixtures on heater tubes, gives better control of the drainage system and avoids flow disturbance inside the heater shell.

The Elliott deaerator follows practice at Logan and Windsor stations. It carries an 0.005 cc per liter oxygen

guarantee and has generous storage.

The single-pass Foster Wheeler condenser is a new inverted "U" tube-bank arrangement and contains 32,500 sq ft of 7/8-in. tube surface.

The 2500-lb main steam line has no valves between superheater outlet and turbine emergency stop valve. The line also differs from normal practice by being anchored at the turbine, leaving a 4½-in. movement to be taken up by the outlet pipes that connect the several superheater stubheaders. This arrangement made possible a steam line of two straight tubes 7⅝-in. ID, 11-in. OD, one 15-ft long and the other just over 34 ft, making a single pipe less than 8-in. dia supply turbine capacity for producing 76,500 kw.

The steam line is carbon-moly steel made by turning and boring a solid forging. Boiler-feed piping is Grade B seamless tubing, 9⅝-in. ID and 1¼-in. thick. Smaller sizes, below 1½-in., were run in copper tubing with silver-brazed fittings.

A Bailey air-operated system is applied to draft-fan vanes and the primary-air damper. Power pistons have been equipped with electrical position indicators. Induced-draft-fan damper-actuators are interlocked with the motor-starting switches so that if one fan should fail its corresponding inlet shutoff damper will close automatically.

A CO_2 recorder, an oxygen recorder, a recorded measurement of the division of gas flow through the reheater superheater convection pass, and the total air-flow-steam-flow boiler meter, plus numerous draft and temperature measurements are necessary for precise operation. A complete supervisory control system has been provided for the compound generating unit. About 60 annunciator alarms give operators warning of any abnormal temperature or equipment condition.

First placed in operation in March of this year, the unit's combined availability record for the first six months was 72.5%. Of the total outage time, 43% was for the turbine and 57% for the boiler. The combined availability for the past three months is, however, up to 88%. Average loads have run about 60,000 kw, 80% of rated capacity.

Starting now takes about 18 hr from cold to 60,000-kw load and experience indicates that this period can be shortened. Thermal performance, too, is now affected by low steam temperatures and there is probability of substantial improvement. To give some idea of the heat rate, however, during 623 hours operation between May 12 and June 6, 32,236,000 kwhr were generated at an average rate of 10,282 Btu per kwhr.

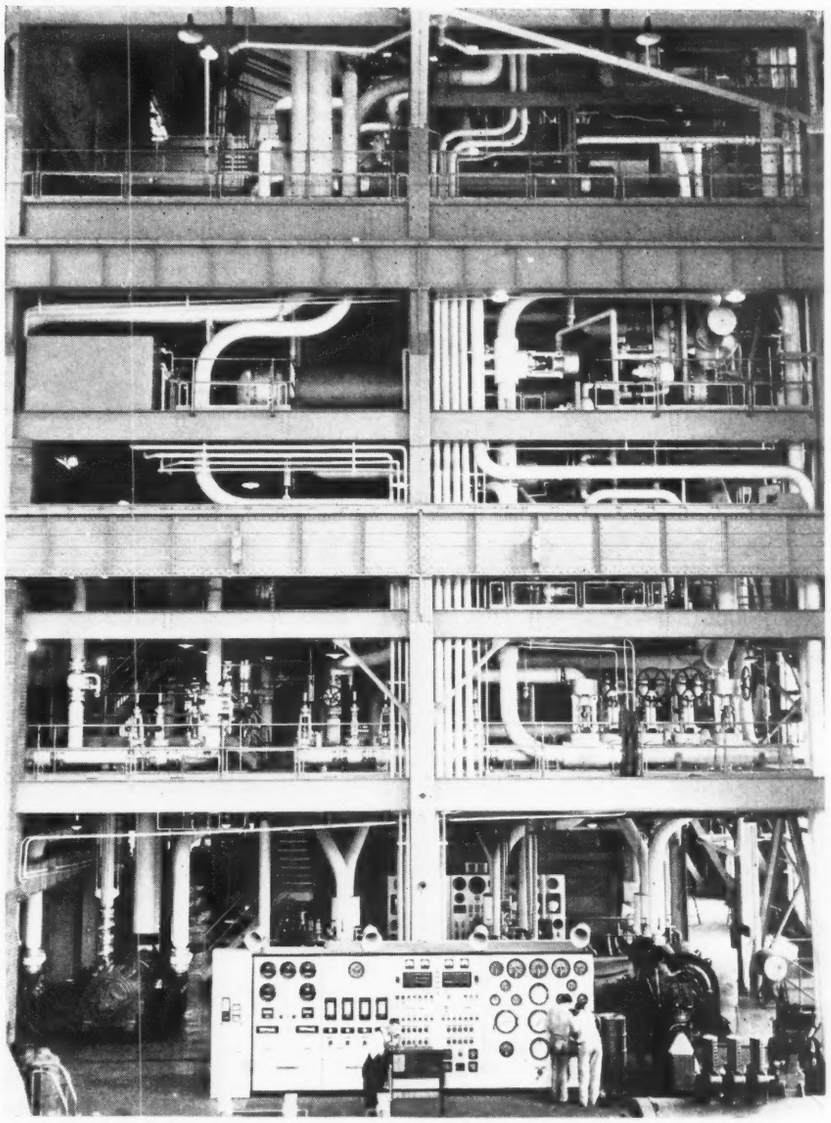


Fig. 4—Heater bay from turbine room. High- and low-pressure turbines in foreground, turbine control-panel and feedwater piping to high-pressure heaters

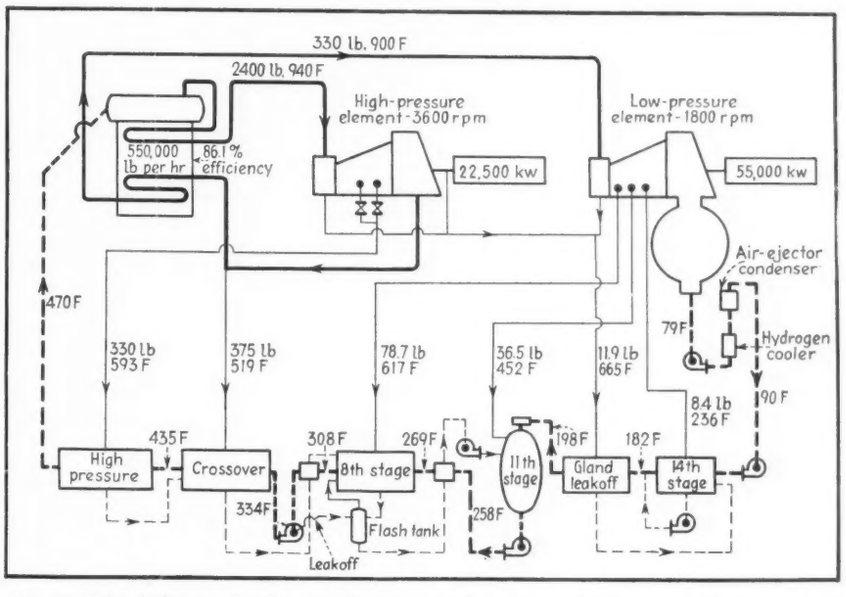


Fig. 5—Heat balance of reheat cycle takes feedwater to 470 F through five stages of feed heating—a carefully made balance between equipment cost and thermal gain

How to Make a Simple Diesel Smoke Meter

Smoky exhaust means high fuel consumption and troublesome soot deposits. P H Schweitzer describes an easily made meter to take the guess out of smoke observation

▶ THERE IS NO MORE dependable indicator of combustion quality in a diesel engine than the exhaust smoke. A clear exhaust shows clean combustion, while a dark exhaust means imperfect combustion. When the exhaust is smoky, high, fuel consumption and troubles from soot deposits can be predicted with practical certainty. However, exhaust observations made with the free eye, give inaccurate results during day time and practically none at night. Exhaust smoke can be judged best with a background of blue sky, but even then quantity of exhaust, observation distance, and personal elements prevent strictly accurate observations. On a cloudy day, or in absence of sky background, visual observations are less trustworthy, and at night impracticable.

A simple smoke meter has been developed in the Diesel Laboratory of The Pennsylvania State College and used there, as well as by numerous other laboratories with satisfactory results. As shown in Fig. 1, it consists of a tube, about 1¾ in. ID, 18 in. long, with a glass window at each end. A 200-watt projector lamp is mounted on one end and an adjustable shutter (a camera shutter will serve the purpose) is interposed between the lamp and the window. A rheostat may be used instead of the shutter to regulate light intensity by changing the voltage. The other end of the tube carries a photocell lightmeter similar to those used for measuring room illumination.

The exhaust enters the center of the smoke-meter tube through ¼-in. copper tubing. The tube is open to atmosphere through two rows of 1/16-in. holes on both ends, 2 in. from the windows. It is advisable to hinge both windows, or make them easily demountable, to facilitate cleaning sooty deposits.

To measure smoke density, scavenge the tube with air, and bring the lightmeter hand to register 50 foot-candles, by adjusting the shutter (or rheostat). Then connect the smoke meter to the engine exhaust, and when the hand assumes its new equilibrium in about 30 sec, record the foot-candle reading. If the reading is, say, 20 foot-candles, the loss in light intensity is 20/50=40 per cent, and the corresponding smoke density is denoted 40. If the instrument registers no loss in light intensity when switching from free air to engine exhaust, then the smoke density is, by the preceding definition, zero.

Besides its extreme simplicity, which permits building the apparatus for approximately $25, there are other points in its favor. Results are independent of light-source intensity, lightmeter sensitivity, deposits on the windows, exhaust-gas velocity, cross-sectional area of smoke-meter tube and the point of location for the exhaust-manifold connecting tubing. The only factor that enters—besides the smoke density—is the length of the tube, which can be conveniently standardized at 18 in. If the windows become obscured during the test, or the light source changes in intensity, adjusting the shutter so that the lightmeter hand registers 50 with free air will neutralize the effect. If the exhaust smoke causes the hand to go back to any point, x, then the smoke density can be found from this relation:

$$\left(100\ \left(1-\frac{x}{50}\right)\right) = \text{smoke density}$$

where smoke density is in percent.

Fig. 2 shows a typical smoke-density record of an engine. It will be noted that between 25% and 75% load the smoke density is practically zero. Beyond the 75%-load point the smoke density increases slowly, while beyond the normal full load it increases rapidly. Against a normal blue-sky background the smoke is just beginning to be clearly visible when the smoke meter registers a smoke density of 50 percent.

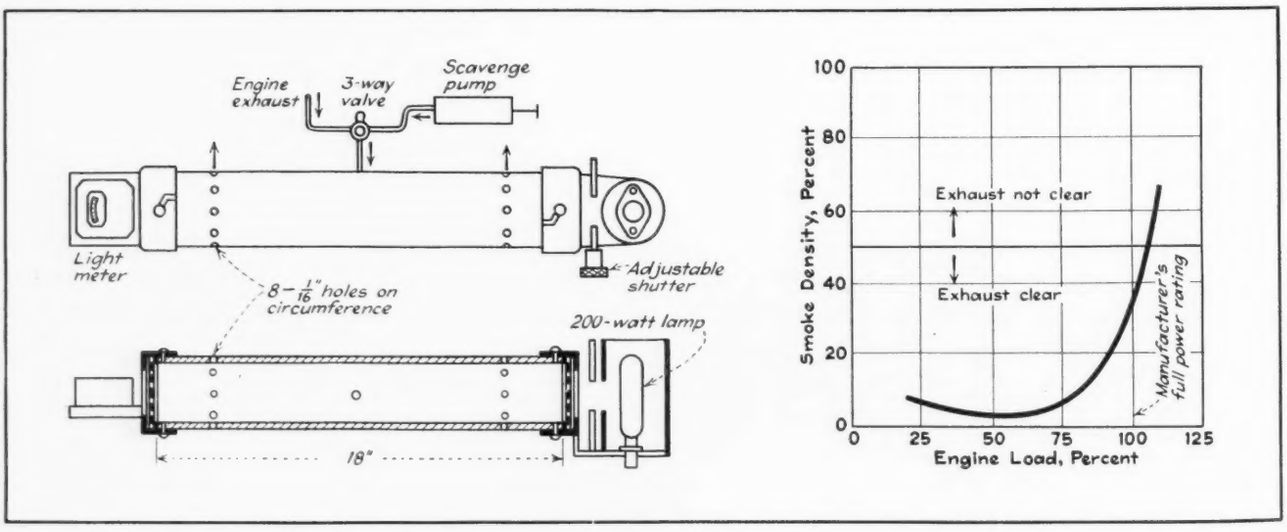


Fig. 1—Exterior view and section of smoke meter. Fig. 2—Typical smoke-meter readings plotted against engine load

Magnetic Variable-Speed Drives Control Boiler Draft

Magnetic units, 21 of them, in sizes from 75 to 250 hp, give speed ranges up to 10 to 1 when driving induced-draft fans

By E T PETRIK
Application Engineer, Electric Machinery Mfg Co

▶ MAGNETIC VARIABLE-SPEED DRIVES between constant-speed motors and fans are being used to control boiler draft at the largest plant of its type, the new Southwest sewage-treatment works of the Chicago Sanitary District. This plant, put in operation in the summer of 1939, has four boilers, having a maximum capacity of 110,000 lb of steam per hour each at 425 lb per sq in., 725 to 750 F. Boilers are fired with powdered coal. Steam is used for turbines driving sewage pumps, air blowers and electric generators. On each of the four steam generators a magnetic variable-speed drive connects the induced-draft fan to its driving motor.

Drive Selection

After considering initial cost, maintenance cost, economy of operation, simplicity and ruggedness of construction, response to control and other factors, the engineers decided that magnetic variable-speed drives were best suited to their draft fans.

In the summer of 1940 a 250-hp trial magnetic-drive unit was installed after being subjected to thorough tests at the factory by engineers of the Chicago Sanitary District. This drive, operated by a 250-hp, 870-rpm constant-speed motor, provides a fan-speed range from 87 to 840 rpm. Operation confirmed the shop-test indications that the drive, under either manual or Hagan automatic combustion control, used in the plant, would give stable, quick-response, wide-range induced-draft control. Based on successful operation of this first unit, three other induced-draft fans were equipped with 250-hp, 87- to 840-rpm magnetic drives. Also, eight 125-hp units operated by 125-hp, 880-rpm constant-speed induction motors to give a fan-speed range of 88 to 854 rpm were installed on dryer induced-draft fans, which draw waste gases from combustion chambers to the sludge-drying

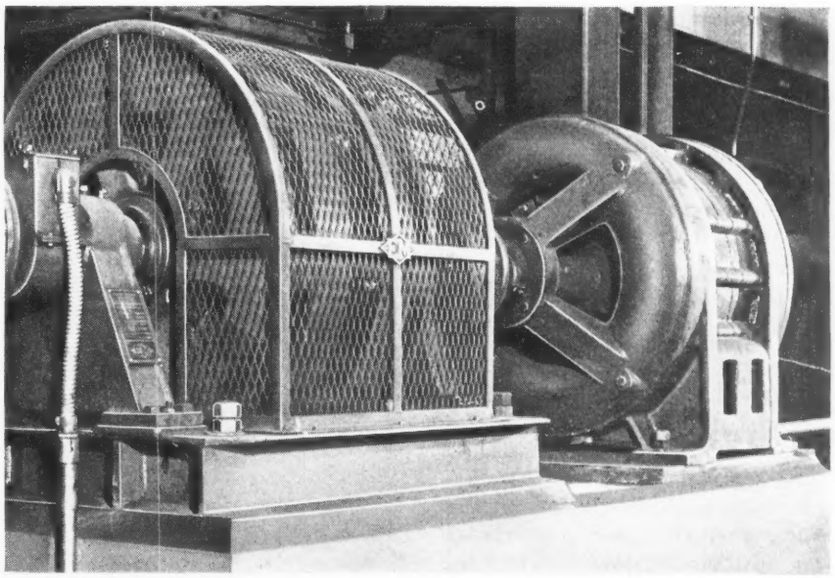


Fig. 1—One of four 250-hp, 87- to 840-rpm magnetic variable-speed drives operating induced-draft fans at sewage-treatment power plant of the Chicago Sanitary District

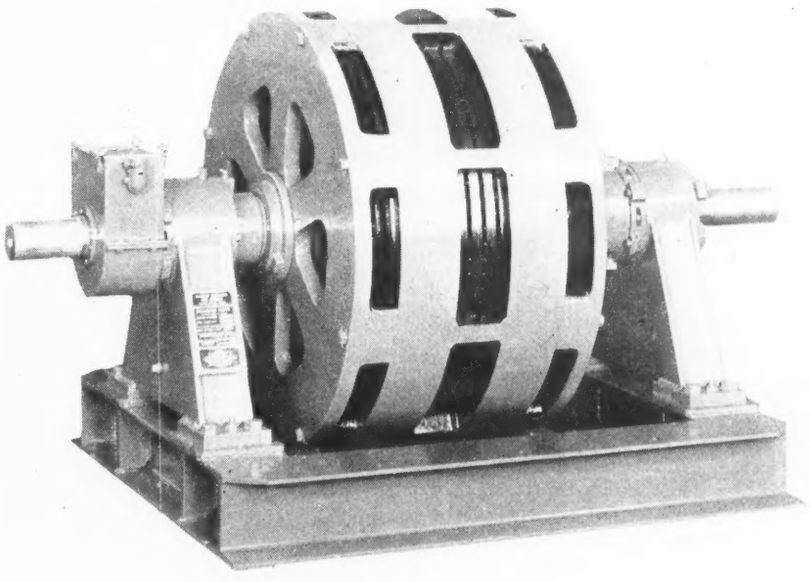


Fig. 2—The same drive, Fig. 1, with screen enclosure removed

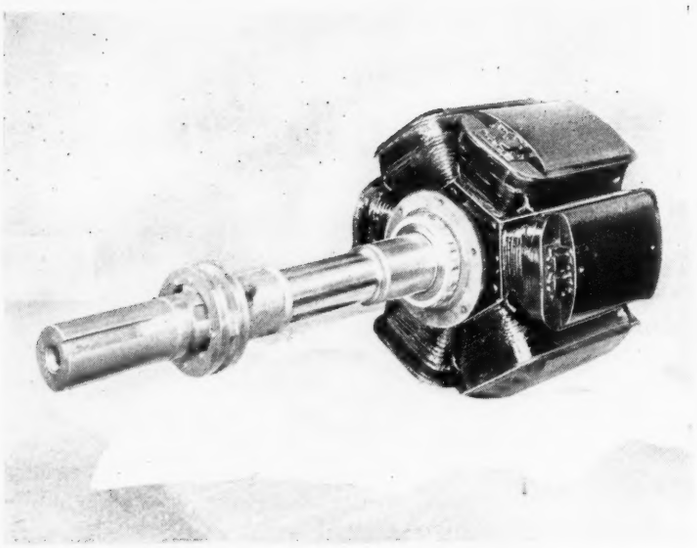


Figure 3

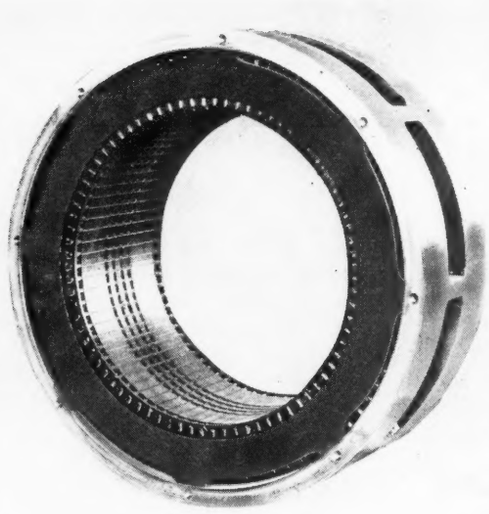


Figure 4

Fig. 3—Salient-pole, multi-coil type of magnet for the variable-speed magnetic drive ring, Figs. 2 and 5. Fig. 4—Ring for magnetic drive has a laminated steel core, with a bar winding similar to the rotor of a squirrel-cage induction motor

chambers. Recently, three 75-hp drives providing 132 to 849 rpm and six 150-hp units with speed range of 133 to 863 rpm have been ordered, making a total of 21 units at the plant.

Four 250-Hp Drives

Fig. 1 shows one of the four 250-hp drives. This unit is self contained, supported on its own pedestal bearings and base, and connected to motor and fan by flexible couplings. Fig. 2 is a view of the unit without the screen-mesh guard in place.

A magnetic drive is an electromagnetic slip coupling, consisting of a magnetic-flux linkage "ring," Fig. 4, and a magnetic-flux producer or "magnet," Fig. 3. In Fig. 4, the ring consists of a circular steel backplate, to which is clamped a laminated, slotted iron core, with a squirrel-cage winding. This core and squirrel-cage winding is similar to the rotor of a squirrel-cage induction motor, except it is adapted to form the outer rotating member of a magnetic drive.

The magnet is like the rotor of a synchronous motor or generator, but has no damper winding in its pole faces. It consists of a steel spider with salient magnet poles attached, Fig. 3. The pole windings are connected to collector rings through which direct current is conducted to the pole windings. Fig. 5 shows the component parts of the magnetic drive and how they are arranged one within the other.

The ring is supported around the magnet by two roller bearings *B*, which permit free rotation. At its right-hand end the ring and magnet assembly is supported by a stub shaft *S*, fixed in the ring frame, in a roller bearing B_1. At its left-hand end it is supported by the magnet shaft in a bearing B_2. It is now possible to hold the magnet stationary and rotate the ring about it on bearings *B* and B_1. All roller bearings are grease lubricated and can be arranged for lubrication while the unit is in operation.

Direct current for exciting the magnet coils is supplied through two collector rings. The ring shaft couples to the driving motor and rotates at constant-motor speed. Coupled to the fan, the magnet shaft operates at a speed determined by the slip between the ring and magnet, controlled by the amount of current permitted to flow in the magnet coils by an adjustable rheostat.

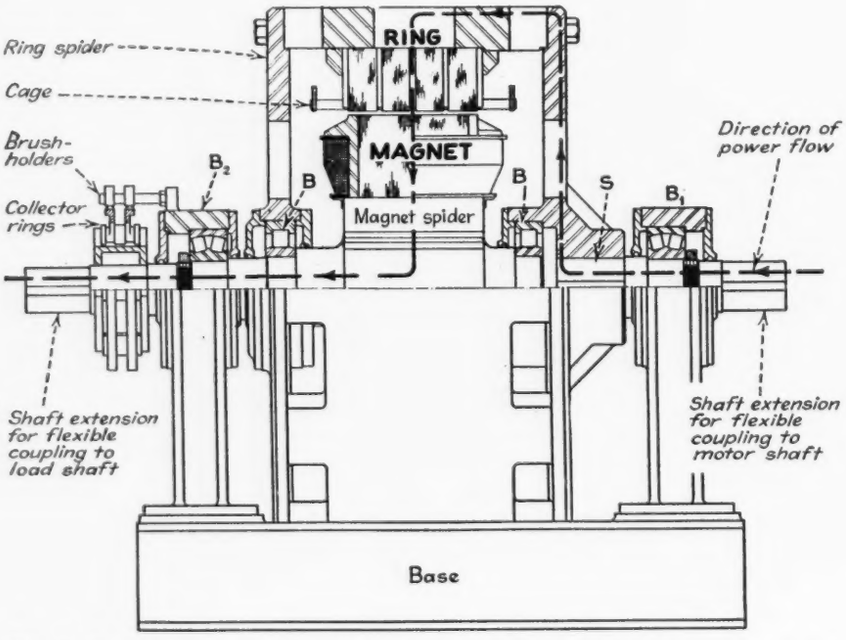


Fig. 5—Speed is controlled by slip between the magnetic ring driven at constant speed by the motor and the magnet connected to the load

Torque Transmitted

When the magnet coils are excited and the ring structure revolved, its cage bars cut the flux of the magnet and electric currents are induced in the cage winding. These induced currents produce a magnetic flux in the ring, which reacts with the flux of the magnet to pull it around with the rotating ring. Torque transmitted from the ring to the magnets depends upon the direct current in the magnet windings. Thus, the fan speed can be controlled by a simple rheostat.

At the Chicago Sanitary District plant the magnetic drives are being supplied with direct current by copper-oxide rectifiers. Supplied by variable-voltage

alternating-current from feeder-type voltage regulators, these are controlled by the automatic combustion-control equipment. Fig. 6 shows the mechanical linkage between control cylinder *C* and voltage regulator *R*.

Rheostat Control

Even though the Sanitary-District installations use rectifiers as a direct-current source for excitation, most other installations take direct current from an existing bus or from a separate exciter. Such an exciter may be direct-connected to the motor operating the magnetic drive, or may be independently driven. Current to the drive is then controlled by a circular plate-type rheostat operated automatically by the combustion-control system, Fig. 7.

No external cooling devices are used with the magnetic drive. The ring member is effectively self-cooled because it always revolves at full motor speed. The magnet member may operate at low speeds, but the somewhat less-effective ventilation is compensated for by the smaller current passing through its coils. Thus, construction and operation of magnetic drives are inherently favorable for dissipation of heat created by load losses.

Tests showed that these drives operate well within the temperature-basis rating of 70 C (158 F) rise by magnetic-winding resistance and 100 C (212 F) by thermometer on the ring-cage winding, based on 50 C (122 F) ambient temperature. The cage winding of the ring is uninsulated and the magnet winding covered with Class B insulation.

Magnetic Drive Losses

Magnetic-drive losses consist of slip loss, which appears as heat in the ring; control current in the magnet coils, which heats the coils; and windage and friction loss. Loss due to slip is the principal one; the other two are quite small. As in slip-ring induction motors and hydraulic-slip couplings, the slip loss of the magnetic drive is a direct function of speed reduction. *Slip loss in hp = (slip in rpm ÷ fan rpm) × fan load in hp at fan rpm.* Maximum slip loss of a magnetic drive on a fan is only 15% of the full-load rating of the drive and occurs at 67% of full speed.

Total loss in a magnetic drive at any given fan speed is the slip loss calculated from the above formula plus control current, windage and friction losses at that speed. In general, the total losses will be lower than when using constant-speed fans with throttled control by vanes or dampers. Although this reduction of losses will vary considerably depending on the nature of the operation, in the case of the Sanitary District the reduction was found to be substantial.

Operating tests were made, intended primarily to demonstrate control stability, speed response to control, satisfactory operating temperatures, and general practical dependability. Stability of control was effectively demonstrated by placing a boiler in operation under varying loads, with the magnetic drive under regulator control. Performance was satisfactory. In an experimental way, stability was demonstrated by operating at a given regulator setting and observing the fan speed; then changing to some other setting and again noting fan speed. Repeated manipulations showed that the fan speed would always stabilize at the corresponding regulator position.

Quickness of Response

Quickness of response in actual boiler operation with varying boiler loads was such that draft control was precise. Experimental checks showed that the fan would accelerate from 275 to 835 rpm in approximately 20 sec by changing the regulator from one position to the other. This test was conducted with cold air and the loads were therefore high, 236-kw input to the motor, approximately 288-hp load on the driving motor.

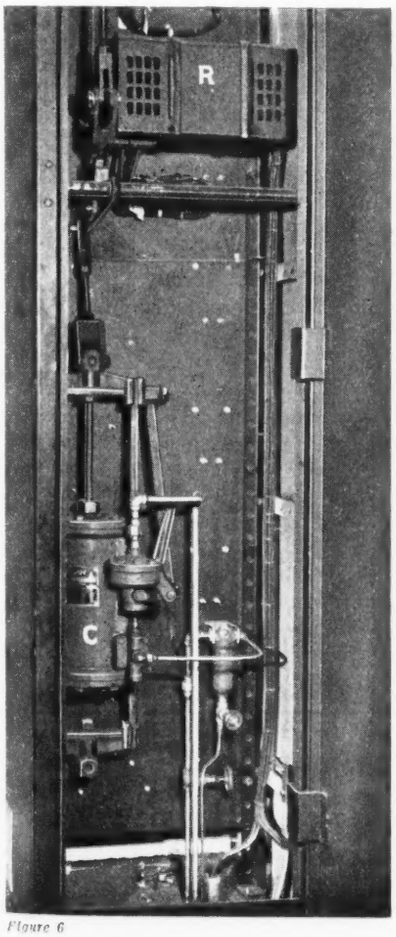


Figure 6

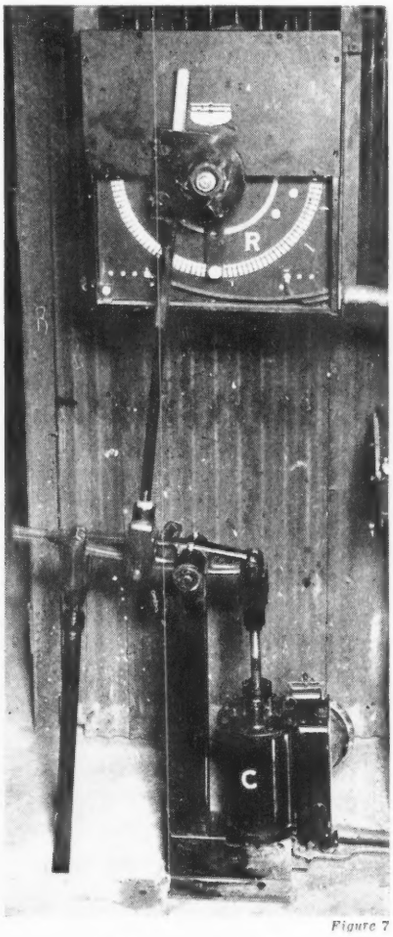


Figure 7

Fig. 6—Output speed of magnetic drives is controlled by a voltage regulator *R* positioned by the automatic combustion-control cylinder, *C*. Fig. 7—Typical speed control for magnetic drive where the combustion control cylinder *C* positions the contact arm of a circular-plate rheostat *R* in series with the magnet coils

✦

Steel Production in U.S. to Reach 99 Million tons

Defense is a long-time program. No matter what happens in Europe, America's great effort will not be over in a hurry. The government is laying plans for a long war, well into 1943, at least. That is why we are going ahead with the 1¼ billion dollar program to expand steel capacity 10,000,000 tons, although it will take three years to complete.

It is worth noting that America's steel capacity was 63,000,000 tons in 1929, 86,000,000 tons July 1, 1941, and will be 99,000,000 by July 1, 1943. This is more than two and a half times the steel-producing capacity of Germany, according to 1941 statistics.

Fighting Power-Plant Fires—I

A review of simple things about fire fighting, brought up to date by W E Rossnagel, Consolidated Edison Co of New York

▶ As explained in October Power, page 72, there are three types of fires: Class A—in ordinary material such as rubbish, paper, wood and fabrics; Class B—in oils, greases, paints, etc.; and Class C—in electric motors, transformers, switchboards and similar apparatus. This article will cover Class A fires, showing the methods and equipment commonly used to fight them.

For Class A fires, the most effective means of extinguishment is by cooling. In power plants, Class A fires are probably the most frequent but the least disastrous, as the buildings are usually fire-proof and there is little to burn except clothes in lockers, boxes in storerooms, and rubbish. In addition, during repairs or new construction jobs sparks from acetylene torches occasionally ignite scaffolds and scrap wood.

All large power plants are provided with standpipes having hose outlets at various locations on each floor. While building codes in different cities vary somewhat, it is good practice to locate standpipe outlets on each floor not more than 200 ft apart so that all sections of the floor, even though separated by partitions, may be reached by the hose stream. A rack containing two 50-ft lengths of 2½-in. unlined linen fire hose with a nozzle and a spanner wrench for joining additional lengths of hose should be at each outlet. The hose should be coupled to the standpipe outlet at all times, except in the building housing the electrical gallery.

The water supply for the standpipe system may come from the city-water system (if pressure is sufficient) or from a roof tank. Sometimes a fire pump supplements the tank, and usually a siamese connection is provided at the sidewalk so that the fire-department pumper can deliver into the standpipe system. Where the pressure is too great at the nozzle for men to handle it safely, adjustable orifices are placed in the connections at the standpipe outlet valves to reduce the pressure to a predetermined value when the water is flowing. Table 1 gives the distances at which the water from standard smooth hose nozzles will be effective at different water pressures at the standpipe outlet through 100 ft of unlined linen hose.

Salt-Water Disadvantages

Health departments are particular that no salt water or impure river water finds its way into drinking-water mains. In some cities, fresh water is required for standpipe service but along the seaboard, salt water is usual in power plants. Salt water has several disadvantages in that it causes corrosion of machinery, short circuits electrical equipment and leaves deposits of salt.

In the interest of safety, neither fresh nor salt water should be used on electrical equipment until the latter has been deenergized. Due to its high conductivity, salt water is very dangerous to the men handling the nozzle should the stream strike "hot" wires or switches. Table 2 gives the distances at which it is believed safe to use fresh water from fire hoses in the vicinity of live electrical apparatus, but it is much safer to shut off the current before using the fire hose.

On incipient Class A fires the 2½-gal soda-acid extinguisher is most effective. This contains a solution of 1½ lb of bicarbonate of soda dissolved in 2½ gal of water. An 8-oz glass bottle with a loose lead stopple and 4 oz of sulphuric acid is secured in a wire cage at the top of the solution chamber. When the extinguisher is inverted, the stopple drops out, allowing the acid to come in contact with the soda solution. The resultant chemical reaction liberates carbon dioxide at sufficient pressure to expel the liquid through the extinguisher hose.

Righting the extinguisher stops the liquid discharge but allows the gas under pressure to be wasted. Once the unit has been used even momentarily, it must be emptied and recharged. Also, whether used or not, it must be recharged annually to insure proper and effective action. This is necessary because gradual absorption of water vapor by the acid reduces its strength.

On the Underwriters' Laboratory approval tag is the designation A-1, which means that it is recommended for Class A fires and that one exinguisher should be provided for every 2500-sq-ft unit of floor area in buildings such as power plants. Only Underwriters' approved equipment should be installed.

It is common knowledge that soda-acid extinguishers have to be protected against freezing. Most persons believe that this means keeping it at a temperature at least several degrees above the

TABLE I—QUANTITIES OF WATER AND EFFECTIVE DISTANCES

For Body of Hose Stream with Smooth Nozzles of Various Sizes

Pressure at standpipe valve	¾-*in. Nozzle distance, (ft)*			⅞-*in. Nozzle distance, (ft)*			1-*in. Nozzle distance, (ft)*			1⅛-*in. Nozzle distance, (ft)*			1¼-*in. Nozzle distance, (ft)*		
	gpm	*horizontal*	*vertical*	*gpm*	*horizontal*	*vertical*	*gpm*	*horizontal*	*vertical*	*gpm*	*horizontal*	*vertical*	*gpm*	*horizontal*	*vertical*
40	97	41	55	124	42	49	151	44	45	178	41	40	196	36	33
45	103	43	59	133	46	56	161	47	51	188	44	44	209	40	37
50	111	46	62	140	49	62	169	49	55	197	46	48	219	43	41
55	117	48	65	144	51	64	178	52	59	206	50	52	229	46	45
60	122	50	68	152	53	68	186	55	64	213	42	56	240	49	48
65	127	52	70	159	55	71	193	57	67	223	54	59	250	52	51
70	131	54	72	165	58	74	200	59	70	232	57	63	260	54	53
80	141	58	76	178	62	77	214	63	75	249	62	69	279	59	60
90	149	61	78	188	66	81	228	67	79	265	66	75	294	63	67
100	158	64	80	197	69	84	240	70	81	279	69	80	310	67	72

freezing point of water, namely 32 F. Few realize that the limit may be the acid instead of the soda-solution. Concentrated sulphuric acid of 1.835 specific gravity has a freezing point of about 30 F. This acid, however, will readily absorb moisture. If the stopple fits too loosely on the bottle, moisture absorption may be quite rapid, lowering the specific gravity of the acid. When reduced to about 1.77 specific gravity the freezing point will have risen to approximately 46 F, Fig. 1.

Soda-acid extinguishers should be kept at a temperature above 50 F. In exposed locations, the soda-acid extinguisher may be stored in an insulated and heated cabinet, shown in Fig. 2.

Turn Current Off

The soda-acid extinguisher also comes in a 40-gal size mounted on large carriage wheels. Due to the high conductivity of the stream from either the 2½- or 40-gal size, it is desirable to label each with a red enameled tag reading "not to be used on electrical equipment until current is off".

The 2½-gal soda-acid unit has a range of about 30 to 40 ft, and discharge takes place for about 60 seconds. The 40-gal extinguisher can throw a stream some 50 or 60 ft.

Where it is necessary to install extinguishers in unheated buildings and where it is not desired to use heated cabinets, an anti-freeze type is available. Some are so designed that, in addition to turning them over, it is necessary to bump them on the floor while in the inverted position to start the chemical reaction.

Although seldom found in modern power plants, water buckets and tanks should be mentioned. A rack containing five 12-qt fibre pails with tight-fitting lids is equivalent protection to one 2½-gal soda-acid extinguisher, and each pail would thus be rated A-5: five pieces of equipment (water pails) per unit of floor area as protection for Class A fires. Sometimes a 50-gal covered tank, full of water, with five galvanized pails submerged in it is provided. Water in a full pail can be thrown about ten feet. Where low temperatures are encountered, the freezing point of the water may be depressed by adding three pounds of calcium chloride to each gallon of water. This will be satisfactory for temperatures down to about 10 F.

In parts of power plants such as storerooms, automatic sprinklers may be installed. These consist of a branched network of pipe of varying sizes, and outlets spaced 10 ft apart both longitudinally and transversely in the building, with additional outlets as required over special hazards. Each outlet is equipped with a sprinkler nozzle having a serrated cap arranged to spread the water being discharged. This device, known as a sprinkler head, is kept sealed by a piece of metal having a low melting point or by a tiny glass bulb filled with liquid which expands under heat. When the temperature reaches about 135 F, solder melts or the glass bulb breaks, releasing the water.

The static pressure should be not less than 15 lb at the highest sprinkler head. This may be provided by a gravity tank on the roof, by a hydro-pneumatic pressure tank in the pent house or by a fire pump.

Subsequent articles will deal with equipment for use on Class B and Class C fires in power stations.

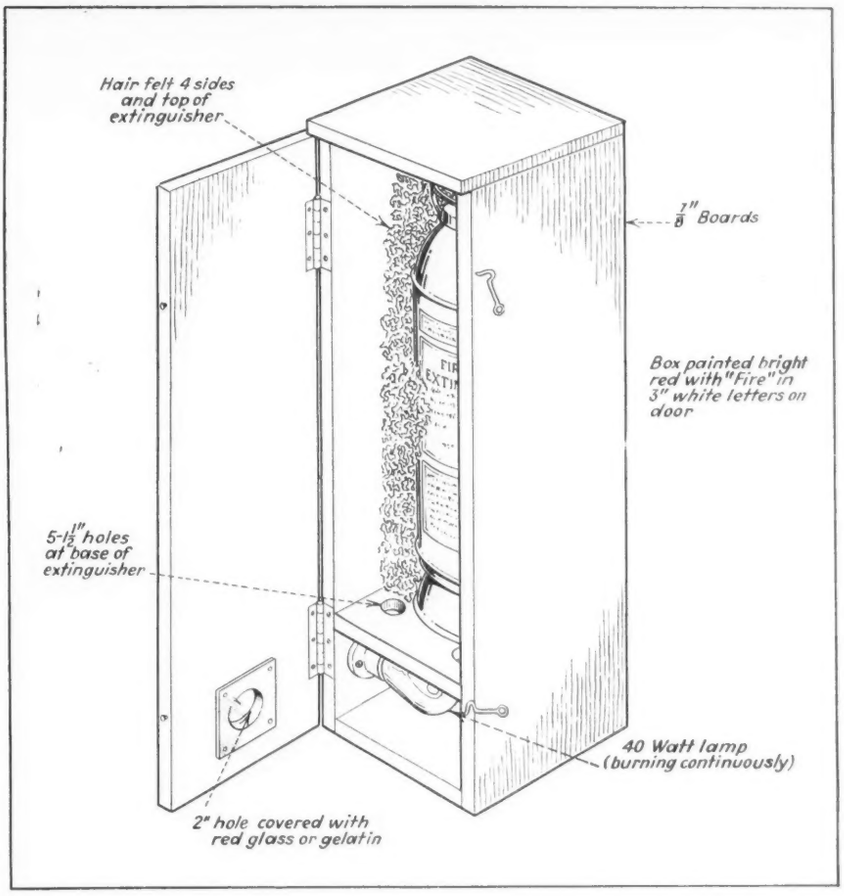

Hair felt 4 sides and top of extinguisher
1" Boards
Box painted bright red with "Fire" in 3" white letters on door
5-1½" holes at base of extinguisher
40 Watt lamp (burning continuously)
2" hole covered with red glass or gelatin

Fig. 2—Insulated cabinet for soda-acid units exposed to temperatures below 50 F

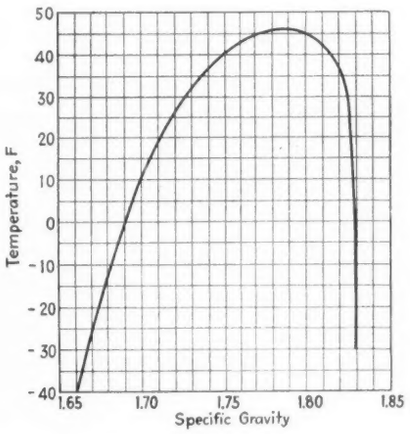


Fig. 1—Freezing temperature of sulphuric acid in soda-acid extinguishers

TABLE II—SAFE DISTANCES FROM HIGH-TENSION CONDUCTORS

	Fresh Water	
Voltage	1⅛-*in. Nozzle*	1½-*in. Nozzle*
1100	6 ft	9 ft
2200	11	16
3300	15	22
5500	18	27
6600	19	29
11000	20	30
22000	25	33
33000	30	40

Stream from foam extinguisher has 2⅛ times the conductivity of fresh water.
Well water has 15 times the conductivity of fresh water.
Stream from soda-acid extinguisher has 27 times the conductivity of fresh water.
Stream from antifreeze extinguisher has 36 times the conductivity of fresh water.
Sea water has 200 times the conductivity of fresh water.

Scovill Tops Its Top

New 650-lb 750-F unit exhausts to 250-lb condensing turbines and bleeding-condensing "top" at end of 4000-ft high-pressure outdoor pipeline

▶ INITIAL OPERATION on June 1 of a high-pressure, high-temperature boiler and topping turbine forms a modern climax to nearly a century and a half of industrial-power history at the Waterbury, Conn., plant of Scovill Mfg Co. From its beginnings in 1802, this oldest of American brass factories has generated its own power; at first literally by "horse" power, then by water power, and, for almost a century, by steam. The story of this development, paralleling the growth of industrial power itself, will be found on page 92; here we are concerned with the record of continuous modernization necessary to keep pace with the changing demands of the last 25 years.

The sketch map, Fig. 1, shows the general outline of the mile-long Scovill works and the location of the east and west power houses. When the heavy loads of World War I came along, the West Power House contained two 500-kw vertical turbines, a 750-kw horizontal unit, and two 250-kw engine generators. Twelve chain-grate-fired boilers supplied steam at 125 lb to these prime movers and to six compound-engine-driven air compressors exhausting to the West Works heating system. The turbines were equipped with barometric condensers.

East Power House construction began in 1915 and two 3500-kw condensing turbines went into service late in 1916. A third similar unit was installed and the turbine room extended in 1919. The boiler house contained eight 6000-sq-ft boilers originally equipped with chain grates designed and built at Scovill's because of war-time difficulty in securing equipment. These were later replaced with Harrington traveling grates. It is interesting to note that this plant was designed for 250 lb at a time when only a few central-stations had dared to use such "high" pressure.

It was in 1929 that Scovill got its first "top"; a rather unusual one, but nevertheless true to the topping principle. It had its origin in the desire to cut costs by centralizing steam generation in the more efficient East Power House. The answer was a 4000-ft pipeline connecting the two plants. One of the 500-kw vertical units and the 750-kw turbine were removed and replaced by a 3000-kw condensing turbine designed for 2-point extraction. The high-pressure extraction (125 lb) supplied the steam-driven compressors and the turbine thus "topped" these units.

The simplified flow diagram, Fig. 2, shows the ingenuity exercised in utilizing existing facilities. In winter, compressor exhaust supplies three closed heaters in the forced-circulation hot-water heating system for the West Works. The lower extraction point on the 3000-kw turbine and the exhaust from the remaining 500-kw vertical unit, kept for standby, supplement the compressor exhaust for hot-water heating. Steam from the 125-lb extraction point also supplies various auxiliaries, and industrial uses in the West Works.

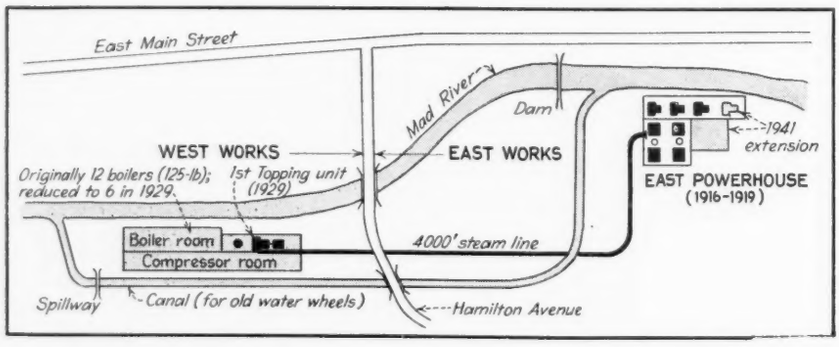


Fig. 1—Sketch map locates east and west power houses and pipeline

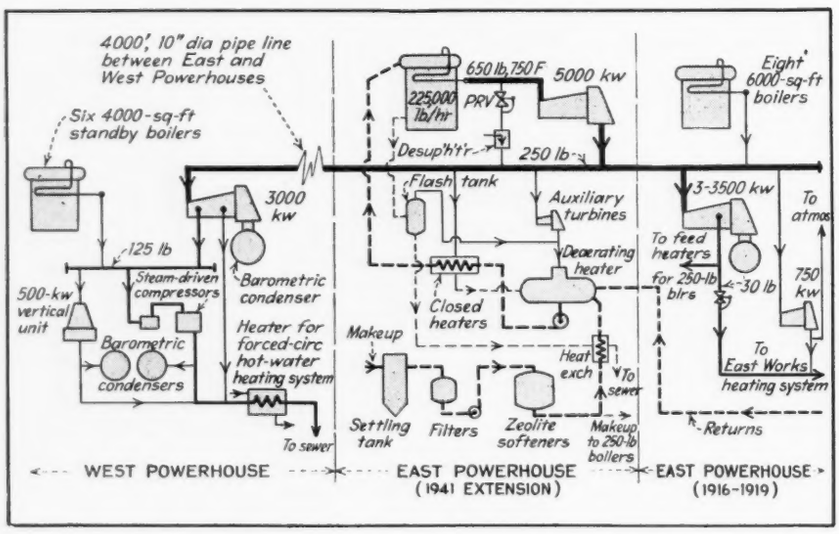


Fig. 2—Simplified flow diagram shows how new and old "topping" units fit into and modernize existing power and steam setup, making maximum use of each Btu

Existing Condensers Used

The existing barometric condensers were all put to use, serving the new turbine, the 500-kw unit, the compressor engines and the auxiliaries, in summer. Under normal conditions, only enough steam goes to the condenser of the 3000-kw machine to keep the last stages cool, but the condenser makes available for emergencies the full turbine capacity. Not only did utilization of the old barometric condensers cost nothing beyond the small sums involved in re-connection, but their operation costs nothing, because gravity does the work. The canal shown on the map, running along one side of the power house, stands high enough above Mad River to maintain water flow without pumping.

The pipeline that takes the place of

the old boilers (6 were removed and 6 converted to oil for standby) is 10-in. in diameter and designed for 500-lb pressure. The 3000-kw turbine is also designed for 500 lb. with a dummy high-pressure wheel, so that the system can operate at the higher level if future circumstances so dictate.

Design of the pipeline, which is all outdoors, aimed at reducing maintenance and possible trouble to a minimum. Covering consists of an inch of high-temperature insulation, 3 in. of 85% magnesia, and sheet-metal lagging. At selected points, rigid anchors divide the line into sections and, between these points, expansion loops and slip joints (where space isn't available for loops) take care of thermal expansion. Single-roller guides on straight runs and double-roller guides at bends support the line between anchors. All bearings on the rollers are chromium plated and require no lubrication. Minor changes in design, and installation of Alemite fittings for packing lubrication, have reduced slip-joint maintenance to the vanishing point. The entire line pitches toward the West Power House and contains not a single drain, all condensate coming out in a large combination separator and receiver at the west end. By eliminating need for handling coal and ash at two places, and three shifts of boiler-room labor, installation of the pipeline paid its $150,000 cost in about 4 years.

"Topping the top" represents the lat-

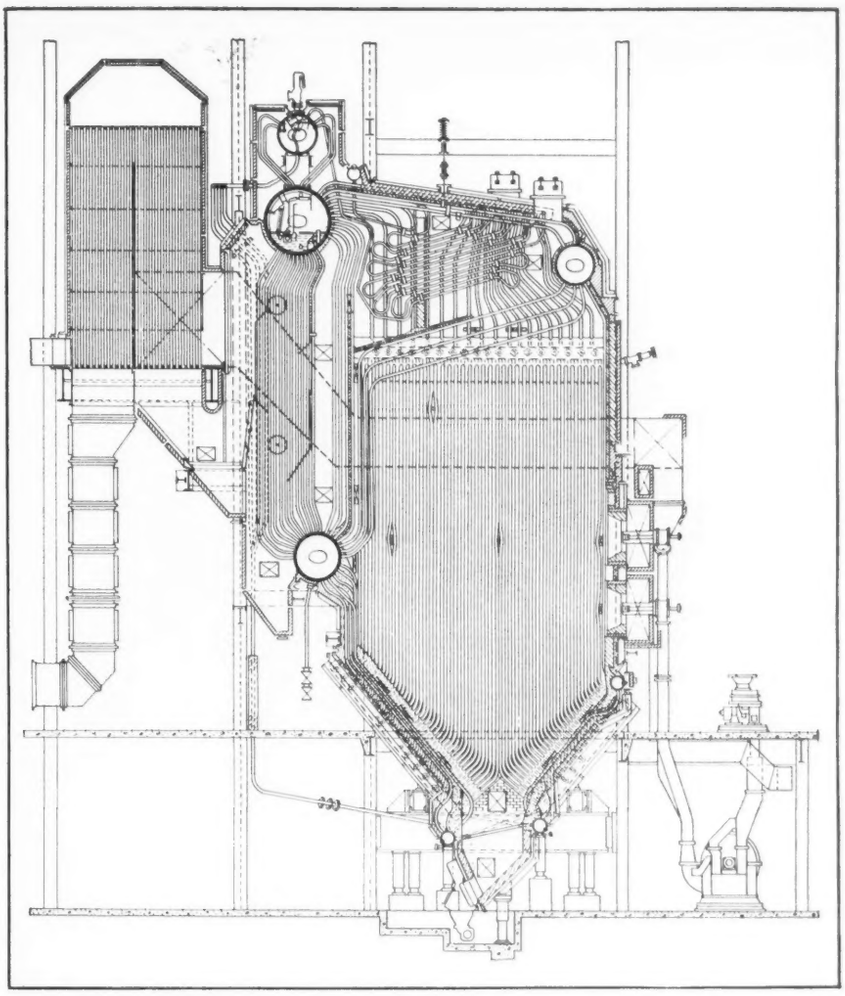


Fig. 3—New 4-drum pulverized-coal-and-oil-fired high-pressure boiler

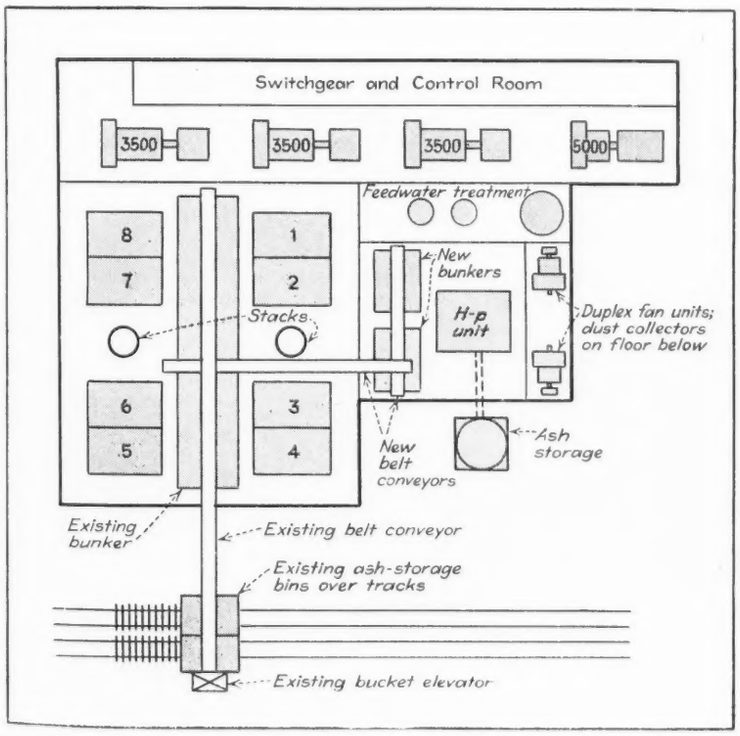


Fig. 4—Rough plan of East Power House, showing new boiler and turbine and modifications to coal- and ash-handling systems

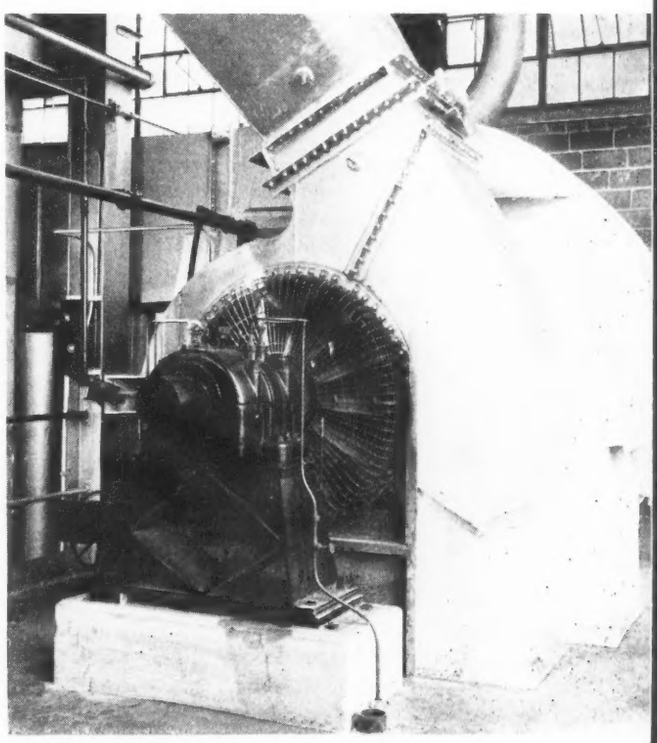


Fig. 5—One of two duplex turbine-driven forced- and induced-draft units equipped with vane control

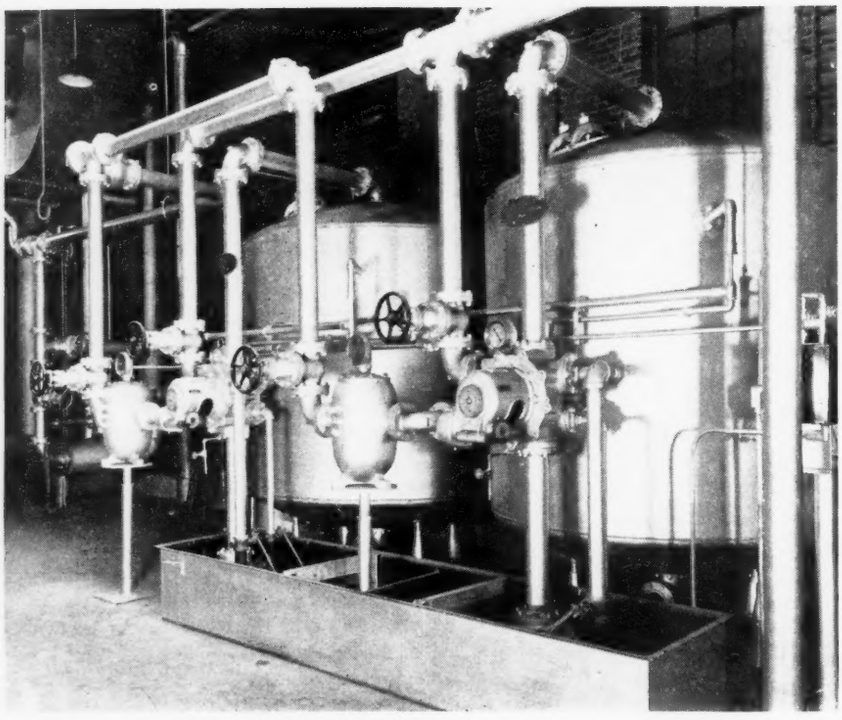


Fig. 6—Two sodium-cycle zeolite softeners in makeup-water-treatment bay

est but certainly not the last step in the continuous modernization of Scovill power facilities. Just as was the case 25 years ago, the present emergency has thrown a tremendous load on the works and the farsighted planning that lead up to the new high-pressure installation is now paying dividends. All steam from the 225,000-lb-per-hr, 660-lb 750-F boiler goes through the new 5000-kw turbine which exhausts at 250 lb to the East Power House turbines and to the pipeline. Several of the older boilers operate to supplement the 250-lb steam from the turbine exhaust.

The new boiler, a 4-drum, bent-tube unit, has a fully water-cooled furnace, with a dry hopper bottom, designed for a conservative heat release of 21,300 Btu per cu ft per hr. The horizontal-flare pulverized-coal burners are fitted with oil burners; on oil the unit has a rated continuous capacity of 250,000 lb per hr. Two 146,000-gal steel tanks (above ground) store oil for emergencies or for use when price is favorable. A combined preheating and pumping unit takes care of oil handling.

Coal comes to the plant by rail from New Haven, where tidewater shipments are received from Norfolk. The coal-handling system for the 250-lb boilers consisted of unloading pits under the tracks, with a bucket elevator to raise the fuel to a belt conveyor running through the center of the boiler house and over the bunkers (Fig. 4). To utilize the existing facilities and avoid unnecessary investment, a belt conveyor was installed at right angles to the existing conveyor, fitted with an unloader at the junction point. Still another conveyor was installed over the new bunker, which parallels the old.

Ash handling in the old plant was unsatisfactory by modern standards: stokers discharged below into cars which were wheeled to the bucket elevator to raise the ash to bins over the tracks. Ash from furnace- and dust-collector hoppers of the new unit goes into a completely enclosed pneumatic system which transports it to an elevated silo just outside the boiler-house extension. A dustless unloader discharges the ash to trucks driven under the silo.

Two forced- and two induced-draft fans serve the new boiler. These are duplex units: a single turbine drives one forced- and one induced-draft fan, mounted on a single shaft. The automatic combustion-control system regulates turbine speed and adjusts the fan vanes. The forced-draft fans discharge through a tubular air heater; induced-draft fans pull gas through the air heater and through multiple-cyclone dust collectors located on the boiler-room floor below the fan platform. The induced-draft fans discharge to the nearest of the existing steel stacks.

In common with many industrial power plants, the new Scovill unit must contend with a high percentage of makeup. During the summer, this runs close to 50%. Raw water comes from Mad River and goes first to a settling tank, where ferric sulphate and soda ash aid in flocculation and coagulation. After passing through gravity filters, the water goes to two zeolite units operated on the sodium cycle. A heat exchanger, fed by condensate from the continuous-blowdown flash tank, raises makeup temperature before it goes to the deaerating heater. Sulphite addition at this point controls residual oxygen and caustic raises pH.

The two boiler-feed pumps, one motor- and one turbine-driven, take their suction from the deaerating heater and discharge through two closed heaters, in parallel, to the boiler. Makeup for the 250-lb boilers comes from the new water-treating system, just ahead of the blowdown heat exchanger. Exhaust from auxiliaries supplies the deaerating heater; steam from the 250-lb system goes to the closed heaters; and steam bled at 30 lb from the 3500-kw turbines supplies the open feedwater heaters in the old boiler house.

Under normal conditions, the high-pressure boiler runs continuously at rated load (225,000 lb per hr), and all this steam goes to the topping turbine. A reducing valve and desuperheater will supply 250-lb 600-F steam to the low-pressure system in case the turbine is out of service. About 50% of the topping unit's exhaust goes to the 3500-kw turbines. In winter, two of these units will handle the load after the topping unit does its share, but in summer, with higher river temperatures, two units cannot swing the job and three must run. Channeling the discharge for some distance downstream, to prevent recirculation to the nearby intake, has improved circulating-water temperature conditions. The remaining 50% of the new turbine's exhaust goes into the long pipeline to supply the older "topping" turbine in the West Power House and through that, air compressors, steam-driven auxiliaries, and industrial uses.

Electric-Furnace Supply

The 750-kw turbine-generator shown in the diagram of the East Power House (Fig. 2) was moved there from the West Power House to provide emergency protection for the electric-furnace supply. Normally, these furnaces receive current from the regular bus and feeders, but in the event of failure anywhere along the line, the 750-kw unit will feed the furnaces directly by a separate cable. Its capacity is adequate to keep the furnaces at "holding" heat and prevent the costly freezeup that would follow complete service failure. Condensing facilities would'nt pay for this standby service, so the exhaust

goes to atmosphere or to the heating system, depending on the season.

The new boiler has met all demands with full satisfaction. Tests and preliminary operating experience indicate that the guaranteed efficiency can be exceeded by a slight margin. Loads in excess of 250,000 lb per hr have been carried, with coal, and it is believed that the unit could produce 300,000 lb per hr if needed. There is a slight tendency to slagging at loads above the continuous rating and because this unit must operate without shutdown during the entire heating season, it is considered safer to hold it to rated capacity.

More H-P Boilers Planned

If demands for steam and electricity continue to grow, space will be made in the 250-lb boiler house for additional high-pressure units, by removing several old boilers. Because of space limitations, these units will be smaller than the present high-pressure boiler, probably about 150,000 lb per hr. each. The first of these projected units will replace the present No. 7 and 8, and the second No. 5 and 6. This will permit utilizing the existing steel stack.

More pressing than steam and power demands at the moment is demand for compressed air. New machines and production methods using air in large quantities and a large volume of building construction have caused the compressed-air load curve to climb at a rate several times as fast as the steam and power curves. When this situation began to grow acute, the main source of compressed air was the six steam-engine-driven compressors in the West Power House, totalling 8700 cfm capacity. In addition, two 750-cfm motor-driven units and three portable gasoline-engine-driven units (two owned and one rented) fed the growing load. When opportunity presented, a new 1500-cfm motor-driven compressor was literally snatched from the market after the original purchaser had decided not to install the unit.

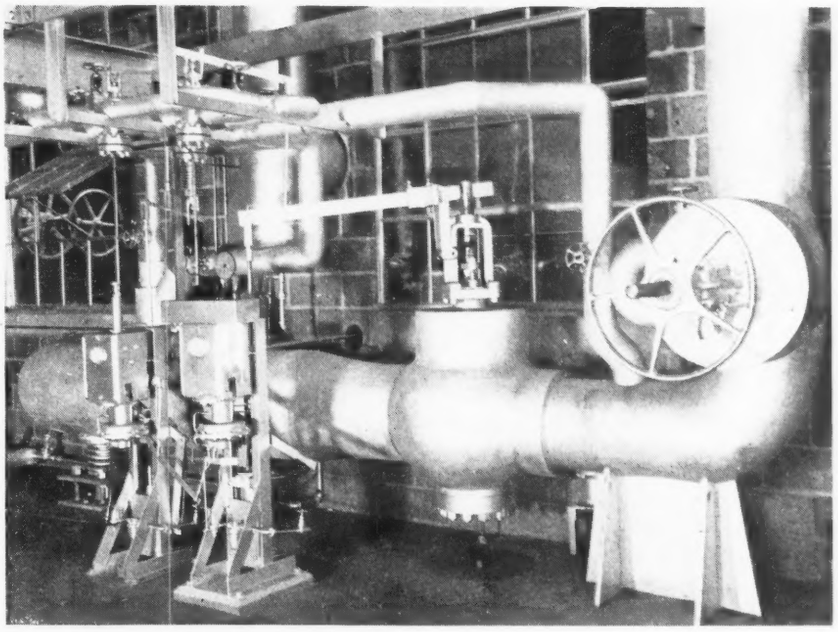


Fig. 7—Reducing and desuperheating station for new high-pressure unit

This acquisition helped, but not enough, and five more portable compressors were obtained, two bought and three rented. With the situation still tight, the high-pressure valve gear on one of the engine-driven compressors failed. To tide over the repair period, the operators hit on the ingenious solution of connecting the high-pressure supply to the low-pressure cylinder. Calculations showed the cylinder would take it, and it did, at least long enough to permit repairs to be made. Delivery of a 5400-cfm unit, driven by a 1000-hp motor and two and a half times as big as any single unit now installed, will relieve the situation, still rather tight.

Operation of this and other Scovill plants is under the general direction of A J German, chief engineer, and Leo Niekerk, asst chief engineer. William Carew and William Foley supervise the East and West Power Houses, respectively. The new installation was designed and installed by Scovill engineers with Messrs German and Niekerk in direct charge and under the general supervision of Hugh L Thompson, consulting engineer of the Scovill Mfg Co. Shepard T Powell was consultant on the water-treatment system.

Principal New Power-Plant Equipment

Scovill Mfg Co, Waterbury, Conn.

Steam-Generating Equipment:

Boilers and water-cooled furnace.....Riley Stoker Corp
One 4-drum unit; 225,000 lb per hr of 660-lb 750-F steam, continuous rating on coal; 250,000 lb per hr continuous on oil; 84% guaranteed efficiency at 225,000 lb per hr; 12,500 sq ft boiler surface; 6812 sq ft waterwall surface; 19 ft 6 in. furnace width; 12,465 cu ft furnace volume; 21,300 Btu per cu ft per hr heat release; 3030 sq ft superheater; and steel-clad insulated setting

Air heater, 33,000 sq ft.....Riley Stoker Corp

Boiler Auxiliary Equipment:

Pulverizers, coal feeders, 2 each.....Riley Stoker Corp
Burners, 4, horizontal flare.....Riley Stoker Corp
Oil burners (combined with p-c units).....Engineer Co
Coal scales, 2.....Richardson Scale Co
Combustion control.....Hays Corp
Soot blowers.....Diamond Power Specialty Corp
Gage glasses.....Diamond Power Specialty Corp
Non-return valves.....Crane Co
Feedwater regulators (Copes).....Northern Equipment Co
Boiler heat insulation.....Johns-Manville

Draft Equipment:

Forced- and induced-draft fans, duplex, 2 units....B F Sturtevant Co
A single Westinghouse 635-hp, 250-5-lb, turbine drives, through a reducing gear, one 40,000-cfm forced-draft fan and one 68,000-cfm induced-draft fan; both fans equipped with vane control

Dust collectors, multiple-cyclone.....Buell Engineering Corp

Fuel and Ash-Handling Equipment:

Belt conveyors, 2.....Link-Belt Co
These connect existing coal-handling equipment to new bunker

Oil pump and heater unit.....Engineer Co
Ash and flyash removal system.....United Conveyor Corp
Pneumatic collection system from furnace hoppers and dust-collector hoppers; storage silo; and dustless unloader

Feedwater System:

Boiler-feed pumps, 2.....Ingersoll-Rand Co
300,000-lb-per-hr 3600-rpm units, one driven by a 500-hp Westinghouse motor, the other by a 450-hp, 250-5-lb turbine

Closed feedwater heaters.....Griscom-Russell Co
Deaerating heater.....Permutit Co
Makeup-water treatment system.....Permutit Co
Settling tank with motor-driven agitator and ferric sulphate and soda-ash feed tanks and pumps; two 10x14-ft gravity filters; two zeolite softeners with brine and salt-storage tanks; sulphite and caustic distributor; phosphate-dissolving tank and pump; two booster pumps

Continuous blowdown system.....Permutit Co
Flash tank; blowdown heat exchanger

Power-Generating Equipment:

Turbine-generator.....General Electric Co
Throttle pressure 650 lb, backpressure 250 lb g; 5000-kw, 3600-rpm, 0.8-pf, 3-phase, 60-cycle, 4600-volt, completely enclosed, air-cooled generator

Miscellaneous Equipment:

Meters and instruments.....Bristol Co, Hays Corp, Cochrane Corp, Foxboro Co, Sentry Co

Piping and valves.....M W Kellogg Co
Backpressure relief valves.....Consolidated Safety Valve Div
Pressure-reducing valve, desuperheater.....Republic Flow Meters Co

Troubleshooting Fluorescent Lamps

Dean M Warren and L R Keiffer, General Electric Co lighting experts, tell of a few things that happen in the life of a fluorescent lamp, their causes, and how to find the trouble source

▶ WITH THE INTRODUCTION of fluorescent lamps three years ago, man-made lighting came another step closer to competing successfully with daylight, both as to quantity and quality. Through this development, not only has artificial daylight been made available at high efficiency, but 50 and more footcandles are now being provided without the discomfort from heat usually associated with high intensities.

This new source, as explained in POWER (Nov 1940, p 74), differs radically from filament lamps both in appearance and characteristics. New information is being accumulated daily regarding the operation of fluorescent lamps under various conditions. As found by actual experience, such factors as temperature, drafts, and various circuit conditions will materially affect lamp performance. Another source of possible difficulties lies in improper equipment connections. These may cause peculiar lamp behavior, sometimes difficult to understand. A knowledge of these factors should enable the user to obtain the most satisfactory service from the lamps, and also enable him to take corrective measures in cases where unusual operating conditions prevail and impair lamp service.

Lamp Sizes

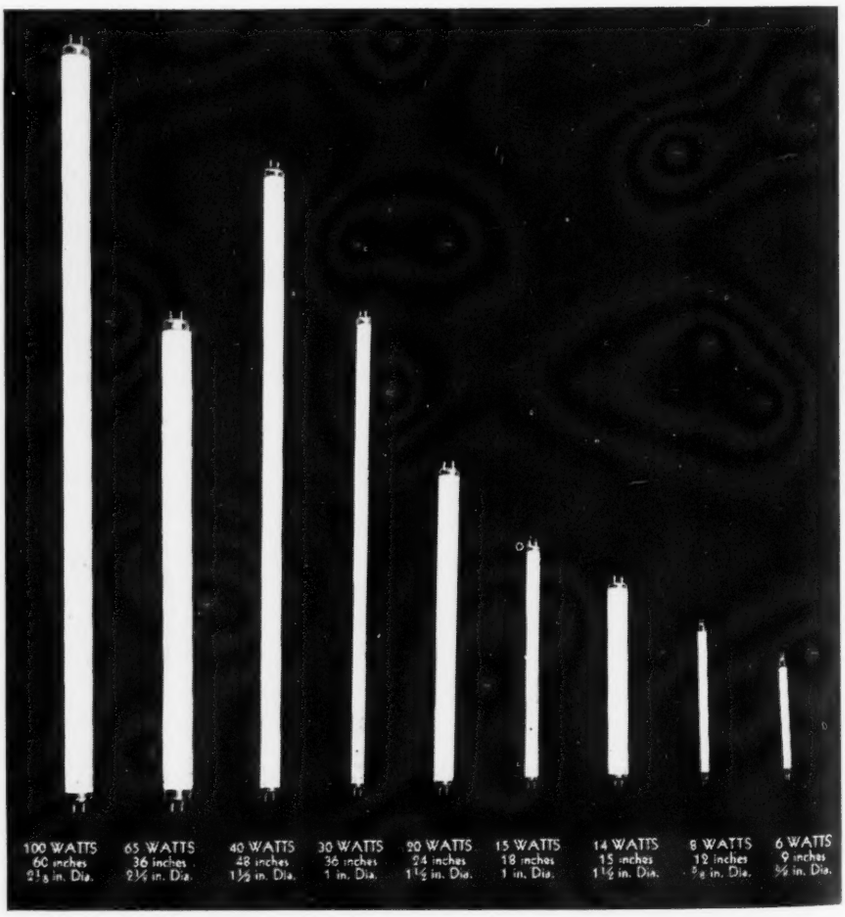
While the common lamp sizes have a design life of 2500 hours, it is not unlikely for some lamps to fail at the end of a few hundred hours, while still others may operate for 5000 hours. With respect to life-expectancy, however, the lamps conform to the same general pattern of the filament lamps, in that the early failures are offset by those of long life. This provides the average of 2500 hours.

Normal lamp failure occurs when the active material with which the electrodes are coated is used up. Most of this material dissipates during starting, giving rise to the observation that switching the lamp on or off repeatedly is an important factor in lamp life. On the average, however, if the lamps are on 3 or 4 hours at a time, they should live their rated life. When the lamps blink on and off at the end of life, it signifies that the active material is gone and that the lamps should be replaced.

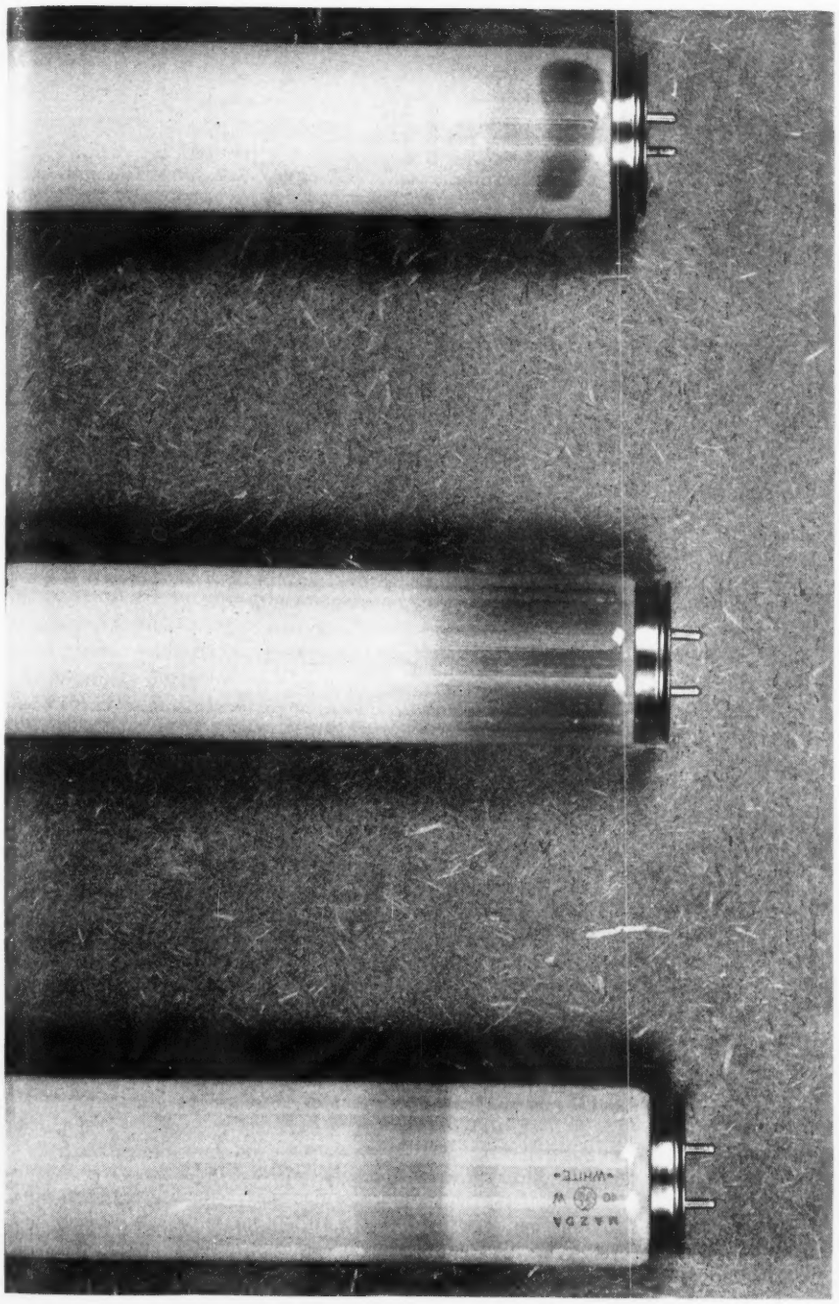
It is normal for the lamp to show a general darkening throughout the tube, but unless a long-life lamp is compared to a new one, the difference isn't noticeable to the casual observer.

Sometimes a mercury deposit collects at the lamp end and is confused with normal end blackening. This deposit is most common in the 1-in. diameter lamps and often becomes evident soon after the lamps are lighted. Generally it evaporates after a short time of operation, although it may reappear after the lamps have cooled. Sometimes, too, a mercury spot will appear on a tube if a cold object is allowed to lie against it for a short time. If this should appear near the center section of the tube it may not evaporate. Rotating the lamp 180 degrees in the socket is often helpful when this situation prevails.

Blackening at the ends of the lamp is a normal occurrence. However, if heavy blackening occurs early in lamp life, it is a signal that the lamp is operating under abnormal conditions. When this occurs it can be generally attributed to



Some typical lamps now in use. Wattages and sizes are manufacturer's figures



Three types of lamp blackening: top lamp shows dense spot which some lamps develop near the end of their life. Early spot-development indicates excessive operating or starting current. Center lamp shows normal blackening, which may develop at one or both ends, and usually extends 2 or 3 inches. Another usual development, although sometimes caused by improper starting, is shown on bottom tube. Rings or bands, slightly brownish in color, may come at either end or both

one or more of the following reasons:

1. No starting compensator in the leading circuit of a tulamp ballast

2. A defective or worn-out starter causing the lamp to blink on or off

3. A defective or worn-out starter which causes considerable flashing of the lamp at the start

4. Starter failure allowing ends of the lamp to remain lighted over a period of time

5. A loose circuit contact (most likely at lampholder) causing lamp to blink on and off

6. Either low- or high-voltage operation (recommended range: 110–125 or 220–250 volts)

7. Ballasts outside specification limits for lamp wattages*

8. Improperly designed ballasts allowing high iron saturation from a magnetic standpoint*

9. Improper design of leading circuit of tulamp ballast*

In general, starting difficulties cause premature end-blackening and short life. A diagnosis of starting trouble usually requires an elimination procedure. If tulamp ballasts are involved, the first thing to check is the possible absence of the starting compensator. This device is necessary in the starter circuit of the leading lamp, otherwise there will not be sufficient cathode heating when the lamps are started. Various causes of starting difficulties are listed in items 1 to 5 inclusive.

Should the lamp make no effort to start, it is quite likely that the starter has failed. After replacing the starter, if the lamp still fails to light, check it on another circuit to determine the possibility of an open circuit in the lamp.

If the lamp makes an effort to start but only succeeds in blinking on and off, one of several factors may be the cause, assuming that the lamp hasn't reached the end of its normal life. The first thing to check is the starter. If the trouble persists, replacing the lamp will often correct it. Other factors that may give the lamp the "blinks" are low circuit voltage, low ballast rating, low temperature and cold drafts.

Ballast Troubles

In the case of tulamp ballasts, the individual starter leads from the two pairs of sockets occasionally become crossed in the fixture assembly. If this is the case, unless the starter switches open simultaneously one lamp will start and the other blink on and off.

Another thing that may happen is that the ends of the lamp may remain lighted. There are two major causes for this: (1) a short circuit in the starter condenser, and (2) welded switch contacts. In either case it is of course necessary to replace the starter.

Sometimes the lamps develop a "spiraling" or "snaking" condition. Generally this is due to the lamp starting without proper preheating of the cathodes. There are several causes of improper preheating, namely: (1) a starter which is not performing properly, (2) starting the leading lamp on a tulamp ballast without starting compensator, (3) high-voltage starting, and (4) starting the lamp with improper auxiliary equipment.

Fluorescent lamps sometimes "spiral" or "snake" during normal life. Generally they clear up in a short while, but if the condition persists the lamp should be replaced. If successive lamps continue to develop this condition, further investigation will be necessary until the particular trouble is located.

* These possibilities should be eliminated by use of ballasts approved by Electrical Testing Laboratories.

Conductivity Cell— Now an Operator's Tool

Low-cost 60-cycle conductivity meters give adequate indication of boiler-water carryover or condenser leakage if simple calibration procedure is used

By RAYMOND T HANLON
Consolidated Edison Co of New York

▶ THE SCOPE of conductivity measurement extends from relatively simple determinations of electrolytic strength of solutions to fairly accurate evaluations of steam purity. In addition, special uses have been developed for process or plant control.

The primary apparatus for measurement of liquids is the conductivity cell. This consists of two metallic plates, insulated from each other and usually enclosed in a container. Distance between these plates is fixed and is determined by the conductivity of the solution to be measured by that cell and by the range and type of the electrical measuring instrument available for use with it. The secondary apparatus is usually a resistance bridge of the Wheatstone type, but may be a voltmeter or an ammeter.

Conductivity cells for laboratory and plant use differ. Laboratory cells are of the pipette, Fig. 1, or dip, Fig. 2, type. For the plant, the chamber-type cell, Fig. 3, is of pyrex glass, rubber or in some cases metal. The shell should be constructed for pressures between 2 and 5 lb and a maximum temperature of 212 F. Samples should flow freely through the space between electrode surfaces. Cell discharge should be so located that complete elimination of samples or test solutions is possible by draining or washing the cell in position.

Another plant cell consists of a pair of plates, properly insulated and mounted upon a metal support, Fig. 4. This can be inserted in a pipeline, tank or other equipment where an indication of change in solution conductivity may be significant. It is similar in construction to the dip cell, except that it must be of rugged design to stand up under operating temperatures and pressures. For some conditions it is necessary that plates be of a harder metal than platinum and coated with platinum black to maintain required accuracy.

Care should be taken to keep electrode surfaces free from any deposit. The presence of any insulating material will cause the resistance between electrode surfaces to increase and introduce serious error into the determination.

A recognized source of error in conductivity measurement is polarization caused by formation of gas bubbles on the electrode surfaces. If direct current is used as a potential source, hydrogen gas will be formed on the cell plate connected to the negative pole, and oxygen on the plate connected to the positive pole. When this occurs resistance across the entire cell is greatly increased, resulting either in non-performance of the cell or in serious error. The error can be overcome by the use of alternating current; rapid changes in charge upon electrode plates tend to preclude formation of gas bubbles. When high-frequency alternating current is used, the error is considerably decreased. Experimental data show negligible error at approximately 1000 cycles. This frequency has been accepted as standard for calibration of cells for ordinary concentrations.

Relative Resistances

The resistance or conductance of any substance depends on material composition, its length and cross-sectional area. Relative resistances of two materials, differing in composition, are compared by determining the resistance of each material of identical length and cross-sectional area. In the measurement of the specific conductance of two liquids, equal volumes of the samples must be measured and compared. The volume usually selected for conductivity measurement is a one-centimeter cube. Specific conductance is expressed in units of micromhos per sq cm per cm of length. This value represents the conductance of the solution across a cubic centimeter block.

For example, assume the distance between electrode faces of a conductivity cell is exactly one cm and the area of each electrode surface is exactly one sq cm. Then the factor of the cell is 1.0, and the value of conductance as read upon a conductivity bridge may be expressed as specific conductance. If the block between the electrode surfaces is more or less than one cu cm the conductance of the solution as read upon the conductivity bridge must be calculated by use of a "cell factor" so that the value read may be expressed in the standard unit of specific conductance.

A cell factor is obtained for each conductivity cell by measuring the conductance of standard solutions of known composition in that cell.

The cell factor of any conductivity cell can be determined by

(1) placing a standard potassium-chloride solution[2] in the conductivity cell,

(2) determining the resistance across the entire cell using an external 1000-cycle ac conductivity bridge at a solution temperature[3] of 77 F. The cell factor is then determined as follows:

$$K = Ls \times R \qquad (1)$$

where:

K = *cell factor*

Ls = *specific conductance of standard potassium-chloride solution as determined by Jones and Bradshaw*[2]

R = *resistance across the cell electrodes as determined using a standard potassium-chloride solution at 77 F and a 1000-cycle ac conductivity bridge.*

[2] Jones and Bradshaw: A Redetermination of the Conductance of Standard Potassium Chloride Solutions, J Am Chem Soc 55, 1780 (1933).

[3] A standard KCl solution should be selected which will yield a total conductivity of between 20,000 and 100,000 ohms. If the characteristics of the cell are such that it is not possible to obtain a bridge reading between these limits then use the standard solution which will result in a bridge reading nearest to either of these values.

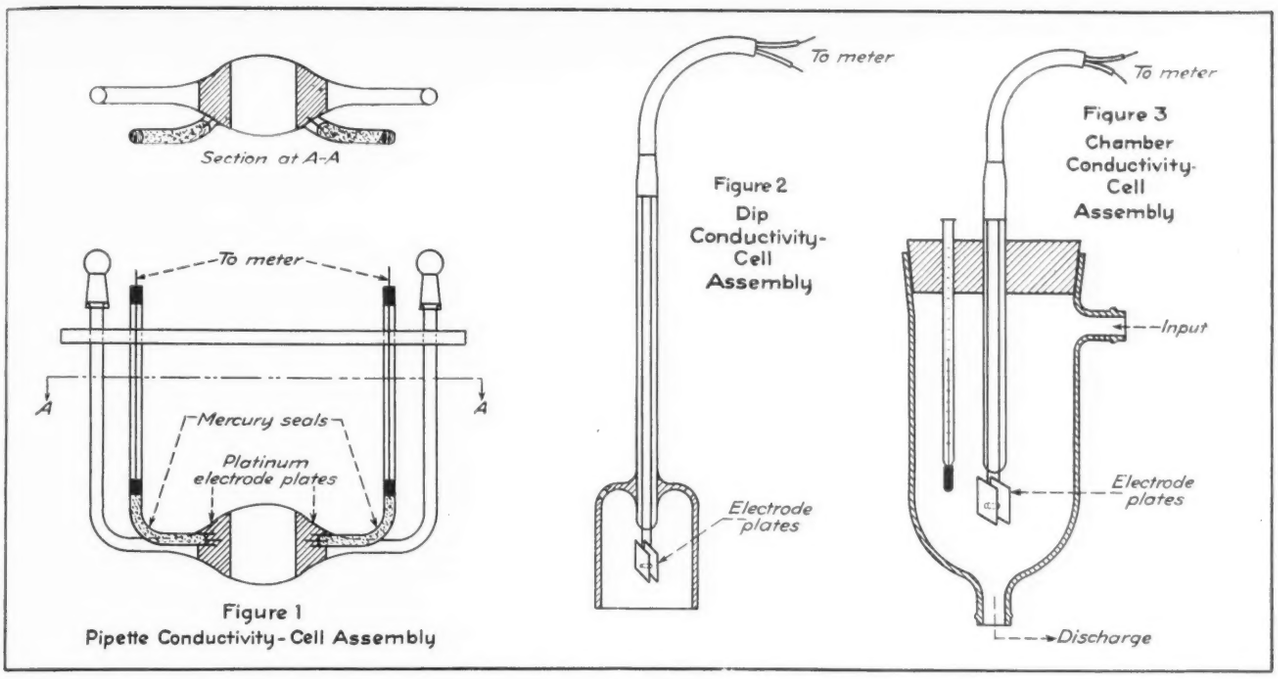


Fig. 1—Pipette cell for laboratory use in connection with standard Wheatstone bridge for conductivity measurement. Fig. 2—Dip cell for laboratory service has plates of platinum, gold, stainless steel or other metal that will not oxidize. Fig. 3 Chamber cell of pyrex glass, rubber or metal for plant use at pressures up to 5 lb g and temperatures up to 212 F

It is unfortunate that it is not possible to obtain a reliable cell calibration unless a high-frequency (approximately 1000-cycle) potential source is employed. This is because the potassium-chloride solutions used for conductivity-cell calibration range between 1.0 and 0.01 N, all of which will cause polarization of the cell at 25-60 cycles.

The cost of high-frequency equipment precludes its use in smaller laboratories. It is not possible, therefore, to calibrate conductivity cells at these laboratories using standard potassium-chloride solutions. Instead, the purchase of a pre-calibrated conductivity cell of the dip or pipette type is suggested for use as a primary standard for calibration of other cells.

This may be accomplished using a 25- or 60-cycle potential source by

(1) determining the specific conductance of distilled or other relatively pure water (specific conductance 1 to 5 micromhos) at 77 F using the standard cell (protecting the water from atmosphere during determination).

(2) determining the specific conductance of a sample of the same water at 77 F using the cell to be calibrated.

In this manner distilled water becomes the standard calibrating solution, substituting for the standard potassium-chloride solutions of Jones and Bradshaw. The factor of the cell to be calibrated is determined in the manner previously outlined.

The impracticability of using high-frequency equipment for routine laboratory and plant conductivity measurements, and the necessary substitution of 25- and 60-cycle equipment results in the possibility of polarization errors in determinations so made. This error is negligible when the electrolytes measured have a specific conductance of less than 200 micromhos. When, however, the conductivity of an electrolyte is appreciably higher than this value serious error will result. Platinization of the electrode surfaces may reduce the error somewhat. Procedures for platinization are discussed in a paper by Jones and Bollinger.[4]

The solution to be measured in a conductivity cell should be representative of the solution as it exists in the pipe line, tank or other plant apparatus from which the sample is taken. This may be accomplished by proper sample-cooling equipment and careful handling of the sample after it is taken. This requires protecting the sample from atmospheric contamination during sampling and subsequent determination. Absolute cleanliness of the conductivity cell, sampling flasks and other apparatus is essential. If a flask is employed, it should be so designed, Fig. 5, that the sample can be discharged to the conductivity cell without exposure to atmosphere.

Determination Procedure

Select a calibrated conductivity cell that will yield a bridge-reading of not less than 1000 ohms and not greater than 100,000 ohms when the electrodes are immersed in the solution to be measured. Maintain solution temperature at 77 F while reading the conductivity bridge. If the bridge is calibrated in micromhos, the specific conductance may be calculated by multiplying bridge reading by cell factor.

If, however, the bridge is calibrated in ohms, the specific conductance of the unknown solution is determined as follows:

$$L = \frac{K}{R}$$

where:

L = specific conductance of the unknown solution

K = cell constant as determined using standard or calibrated solutions

R = cell resistance in ohms as determined using an ac bridge.

To express the specific conductance of

[4] Jones and Bollinger, the Measurement of the Conductance of Electrolytes. VII. On Platinization. J Am Chem Soc 57, 280 (1935). This method entails the use of a platinization solution containing 0.3% platinum chloride and 0.025% lead acetate in an 0.025 normal hydrochloric-acid solution. Platinum is electrolytically deposited using a direct current slightly in excess of one milliampere per sq cm of surface to be coated. Deposition is continued for 10 min with current reversals at 10-sec. intervals. Conductivity electrodes platinized in this manner exhibit a smooth, uniform, dull black surface which will be maintained over relatively long periods of time. An improperly platinized electrode will exhibit either a bright platinum surface or a rough irregular formation that will flake off within a short period.

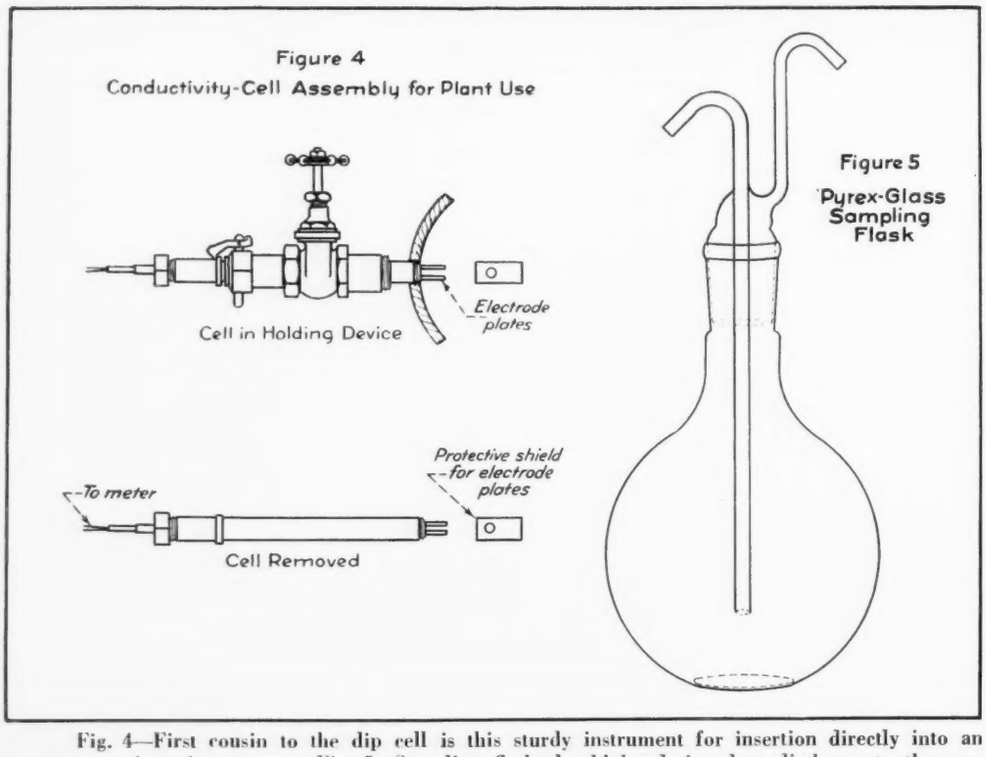


Fig. 4—First cousin to the dip cell is this sturdy instrument for insertion directly into an operating pipe system. Fig. 5—Sampling flask should be designed to discharge to the conductivity cell without exposing sample to atmosphere

the solution in micromhos use formula:

$$L = \frac{K \times 1{,}000{,}000}{R}$$

All data reported as a result of conductivity measurements should be in terms of specific resistance or preferably in specific conductance.

A method has been widely used of converting conductivity readings to ppm dissolved solids, dissolved salts, or a specific salt. Variation in specific conductance of the individual salts usually present in an industrial water precludes this practice unless the chemical composition of the water is known to be constant, in which case corrections may be applied for the conductance of the individual ions in the solution.

Specific resistance or conductance can be applied directly as an index of steam-condensate quality until a better chemical background is available for determination of small quantities of salts present in such solutions.

Bridges for use with conductivity cells are divided into two general classes (1) those operating with a high-frequency potential source for precision measurements and (2) those employing a 25-60-cycle potential source for routine laboratory measurements and plant determinations. In general the high-frequency equipment is confined to cell standardization. It is often employed, however, as a primary standard for routine checking of less precise conductivity equipment.

An excellent high-frequency resistance bridge is discussed by Shedlovsky.[5] This bridge may be operated at frequencies from 600 to 8000 cycles. A grounding circuit is provided to minimize earth capacity effect. Means are also provided to correct for cell capacity. The entire measuring circuit of the bridge is shielded. A sensitivity of 0.001% is claimed when measuring a value of 1000 ohms or greater.

It is also possible to obtain a high-frequency bridge as a manufactured unit. This instrument, discussed in a paper by Dike,[6] is known as the Jones conductivity bridge. The Jones bridge may be used with a dc source as well as with ac up to 3000 cycles. This instrument is generally similar to the bridge discussed by Shedlovsky except that it is only partly shielded.

A wide selection of electrical-measuring equipment operating from a 25-60-cycle potential source can be obtained. The average over-all accuracy of the best of this type of equipment, independent of cell error, is aproximately 0.5%. Some equipment of this type, however, may have errors of from 1 to 2%, independent of cell error.

Some multi-range instruments have a built-in galvanometer. Connections may be provided for the inclusion of a precision external galvanometer if an increase in accuracy is desired. Power input is usually through an insulating transformer which isolates the measuring circuit from the ground. The range of this type of bridge may be varied from 0.3 to 30,000 ohms by the use of a bar-and-plug arrangement by which the scale reading is multiplied by 1, 10, 100, 1000 and 10,000. This type of instrument is designed primarily for laboratory work where the high precision obtainable with 1000-cycle equipment is not essential. The instrument may also be adapted to plant determinations.

Other 25-60-cycle equipment is available in a slide-wire type resistance bridge, equipped with a selector switch by which bridge range can be varied from 0.2 to 25,000 ohms. Balance is indicated by means of a 6-N-5 cathode-ray tube. This apparatus is particularly adapted to plant determinations because of portability and rugged construction. It is possible to use this bridge with excellent results in all determinations of specific conductance except where extreme accuracy is required or where polarization error precludes the use of 25-60-cycle equipment.

A brief summary of the findings to date indicates that the accuracy of any conductivity cell and auxiliary apparatus depends primarily on cell calibration. Too much stress has been placed upon polarization, capacity, and other cell errors when cell-calibration technique was such that larger errors were introduced as a result of calibration procedure than could possibly have originated from polarization or other cell errors. Present designs of 25-60-cycle electrical measuring equipment are sufficiently accurate for industrial application.

Platinization of cell surfaces is not essential in industrial work unless extreme accuracy is desired and the solution to be subjected to conductivity determination has a specific conductance of more than 200 micromhos. Insufficient data exist at the present time to make any conversion from conductivity values to ppm total salts or any one salt unless the chemical composition of the sample is known. The practice of expressing steam purity as ppm total salts when this expression is predicated upon conductivity values alone should be discontinued until better chemical background is available.

[5] Shedlovsky, T, A Screened Bridge for the Measurement of Electrolytic Conductance. J Am Soc 52, 1793 (1930).

[6] Dike, P H, A Bridge for the Measurement of the Conductance of Electrolytes. Rec Sci Insts 2, 379 (1931).

Dust Collectors Put Old Stacks to Work

Ingenious tailoring of dust-collector installations utilizes existing stack construction. Two typical but individually different instances are reported by John E Watson, Prat-Daniel Corp

▶ THE BELL of an existing steel stack or the sawed-off section of an old concrete chimney are hardly the first places one would think of for locating dust collectors, yet they present possible solutions to the usual situation where a cinder or fly-ash nuisance exists but no room is available for collection equipment.

Even though the flue-gas dust concentration leaving a pulverized-fuel boiler in Warren, Ohio, was not high, the operators' desire to remove any possibility of complaint by installing dust-collection equipment was handicapped by lack of space between air heater and induced-draft fan. The dust collector could have been placed after the fan at the cost of considerable change in existing apparatus and structural steel. Some other solution seemed imperative.

Taking advantage of the bell construction of the stack base, collector tubes were so arranged that clean-gas outlets penetrated the main stack wall, with discharge ends projecting into the clear space under the stack bell, Fig. 1. At emergency or overload conditions at which it might be necessary to open the bypass dampers, a bomb-

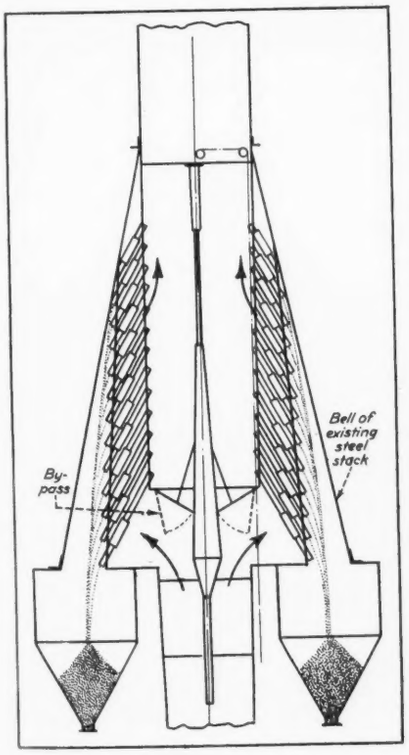


Fig. 1—Holes in existing stack wall take clean-gas outlets of tubular elements. Outside plate of stack bell acts as part of collection hopper

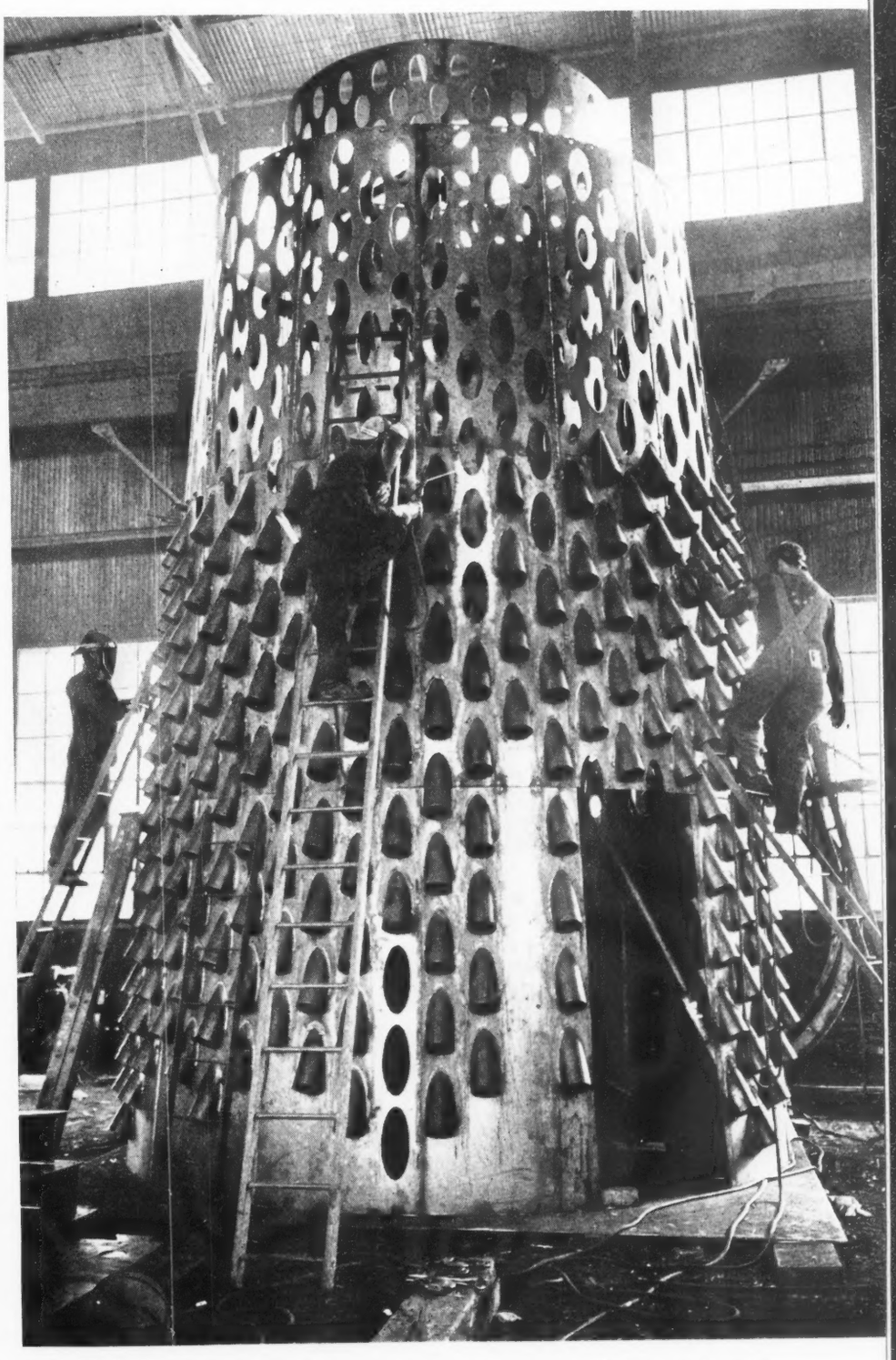


Fig. 2—Shop view of tubular collector now in service in Warren, Ohio, central station on a 300,000-lb-per-hr pulverized-fuel unit

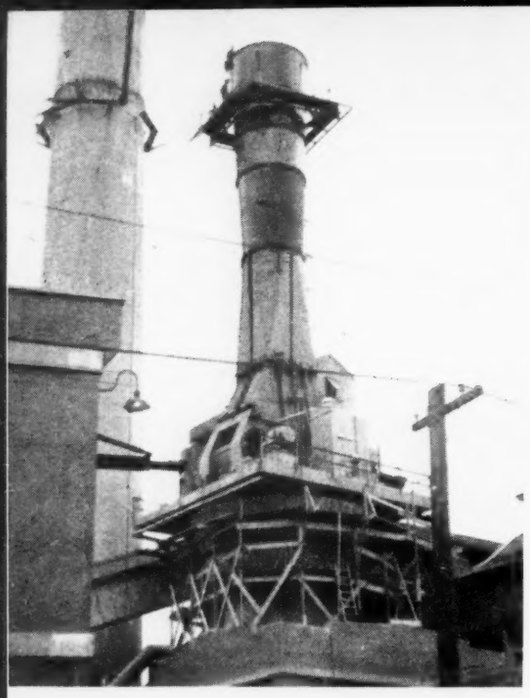


Fig. 3—Fans and dust collector mounted on cut-off stub of an old concrete chimney. Flue gas discharges through a new section of steel stack

shaped baffle at the stack opening tends to concentrate the dust in the portion of the flue gas passing to the collector. It is interesting to note that tests have shown higher collection efficiency with loads that require opening the bypass, because high gas flows result in maximum centrifugal effect within the collector tubes.

Another unusual arrangement was necessitated by the extreme shortness of a duct connection between the economizer and stack at the Worcester County (Mass.) Electric Co. The plant's four 200-ft stacks are close to residential sections of the city. Of four batteries of underfeed-stoker-fired boilers, one bank only was accountable for most of the cinder production.

Cutting the 200-ft concrete chimney that served this bank of boilers created a working foundation for a permanent steel platform, Fig. 3, about 50 ft above ground level. A twin-fan and dust-collector combination was installed on this platform.

The fan overcame the resistance of the dust-collector, eliminated an old induced-draft fan and made up for the loss in natural draft caused by reducing the stack height. The new évasé stack, Fig. 4, ends about 125 ft above ground and the combination of fan and stack produces about 2.5-in. mechanical draft above that required for dust collection.

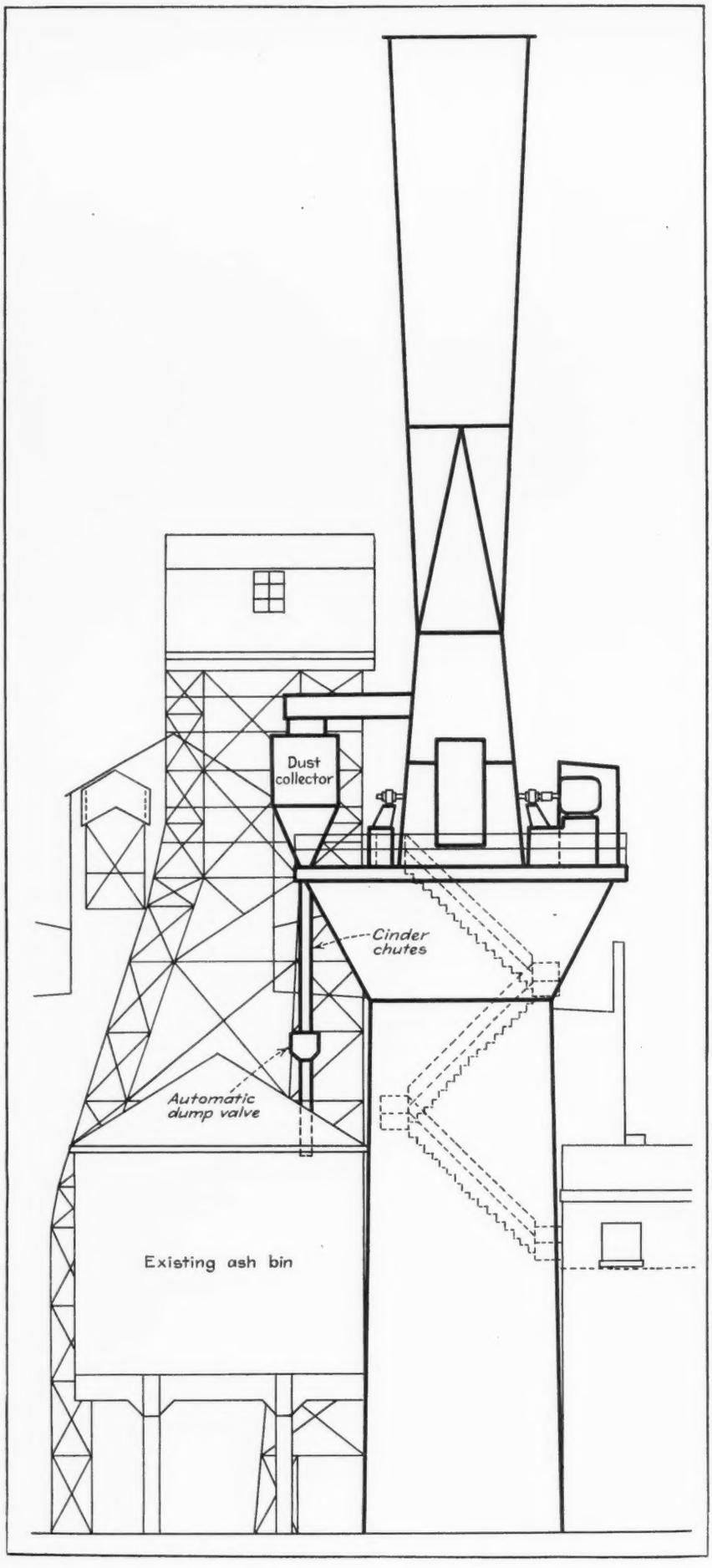


Fig. 4—Permanent steel platform built on 50-ft of concrete chimney supports fan and dust collector at Worcester, Mass.

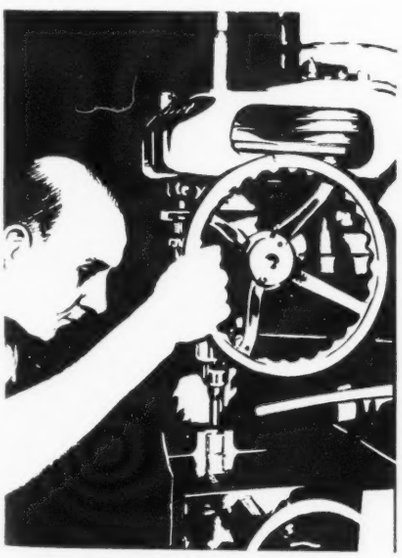
DEFENSE DIGEST

Trends, troubles, achievements, shortcomings, gossip and sidelights of the National Defense Program, with particular reference to industry's job of production, in which the power engineer is a key man

Power equipment feeds defense in unexpected ways. York Ice Machinery Corp, for example, will supply a 7000-ton refrigerating system to air condition the mammoth windowless Douglas bomber assembly plant now going up at Tulsa, Okla. York will furnish 7 steam-turbine-driven turbo-compressor water-chilling units. In this huge plant, 320x4000 ft, blacked out from natural atmosphere and natural light, air conditioning and artificial light will insure fully controlled atmosphere and illumination to speed defense production.

SPAB—(the Supplies, Priorities and Allocation Board) has called for expanded production of every critical material to meet the needs of the all-out defense program. Special attention will be concentrated on aluminum, magnesium and copper—particularly the speeding up of action on new capacity already planned. The expansion of copper production is to be paralleled by a broad campaign to cut unnecessary uses.

Skilled labor shortages will likely become critical within the next few months, despite the fact that more than 2,000,000 employes are expected to be released by reduction in various civilian lines of production. Only a fraction of these will be available for defense work for one reason or another—lack of skill, unwillingness to shift to new locations, etc.

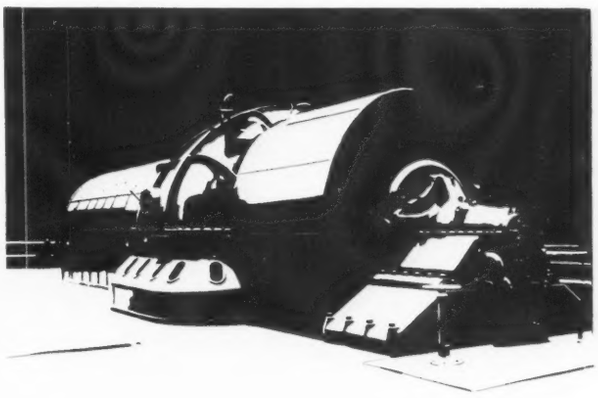


Thus, although defense has created a great deal of synthetic prosperity, it may father industrial troubles as well. For certain lines of business the next two or three months may be the toughest in years. Despite plenty of orders, it is now clear that some lines will be unable to find the materials, supplies, labor.

British utilities are meeting the blackout problem by bricking up windows (to avoid the hazard of flying glass) and a system of pilot lighting of instruments and controls. The latter, of low intensity, can serve in event of damage to main walls or other contingency that requires sudden turning off the main lights. Other reports reaching this country indicate that power loads in Britain are increasing due to electric cooking and domestic heating equipment; electric service has been found less affected by aerial bombardment than gas, and repairs are effected more quickly.

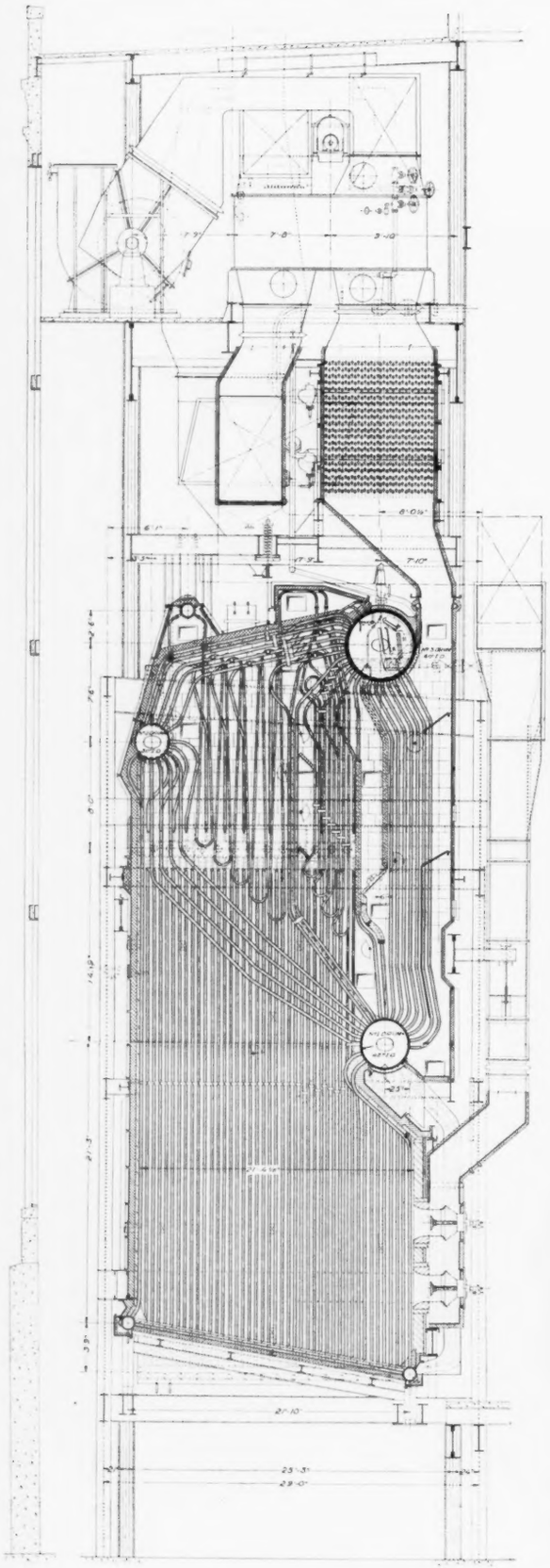
"Cap" Krug, power czar, but still engineer at heart, has called for more help to set up priorities on power equipment. After John C Parker returned to Consolidated Edison of New York, Cap appointed E W Morehouse, once rate analyst for Wisconsin Public Service Commission and more recently of the Associated Gas & Electric system trustee's staff, D D Chase, Detroit Edison, K W Miller, Commonwealth Edison, Walker L Cisler, Public Service Electric & Gas of New Jersey, O A Horner, G E, and Francis H King, Burlington, Vt., municipal plant.

Treasure hunt (one of the biggest in American history) is under way—a nationwide search for new supplies of strategic minerals hitherto largely imported. The U. S. Bureau of Mines has already inspected more than 700 of several thousand alleged deposits. To date this has involved more than 15 miles of diamond drilling, 4,000 ft of shaft sinking, and 20 miles of road and trail building. More than 22,000 samples have been received for analyses. Chief objects of the search are mica, quartz, crystal, antimony, chromite, manganese, mercury, tungsten, nickel, tin. Results are more encouraging than had been expected, supplies authorities report.



New generating capacity is going in service at an ever-increasing rate. The first eight months of the year started over a million new kw rolling; July alone accounted for 277,500 kw; even this pace will be stepped up by year-end schedules. Loads are up, too, about as expected; July kwhr sales ran 19% over the same month last year while aggregate peak loads, according to Federal Power Commission were up 14.7%, showing better load factor.

Florida and California may battle about their climates



While the controversy over which state has the better climate will undoubtedly continue, Florida and California can apparently agree when it comes to a question of steam generating units—both Florida and California have recently selected Riley Units.

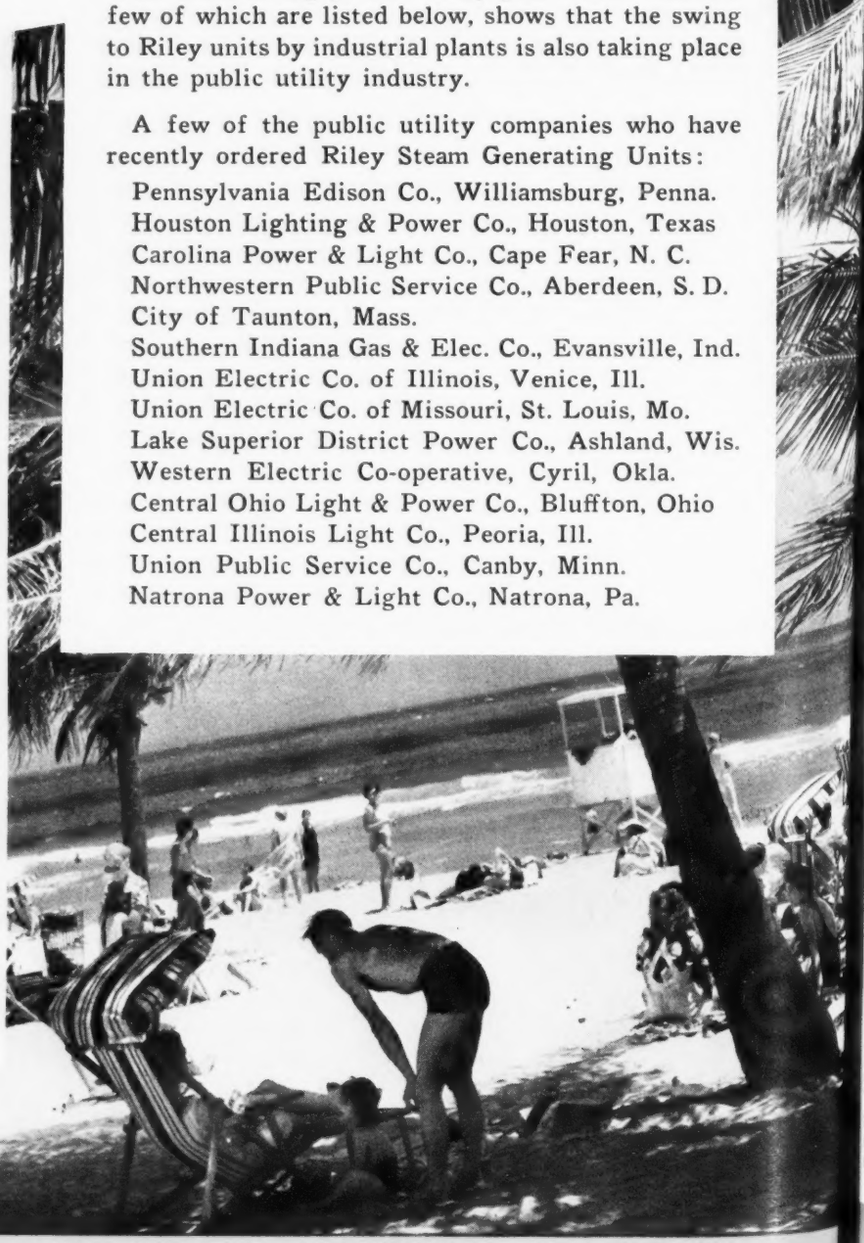
The City of Los Angeles is now installing one 675,000 pounds per hour Riley unit and has just ordered a duplicate unit to be installed in 1943. These are the largest steam generating units in the west. The units will operate at pressures of 1091 pounds and steam temperatures of 915° F.

Florida Power & Light Company recently placed into operation a 300,000 pounds per hour Riley Steam Generating Unit, one of the largest in the State of Florida. This unit will operate at 1025 pounds pressure and 908° F.

Orders for Riley Steam Generating Units from these outstanding public utility plants and others, a few of which are listed below, shows that the swing to Riley units by industrial plants is also taking place in the public utility industry.

A few of the public utility companies who have recently ordered Riley Steam Generating Units:

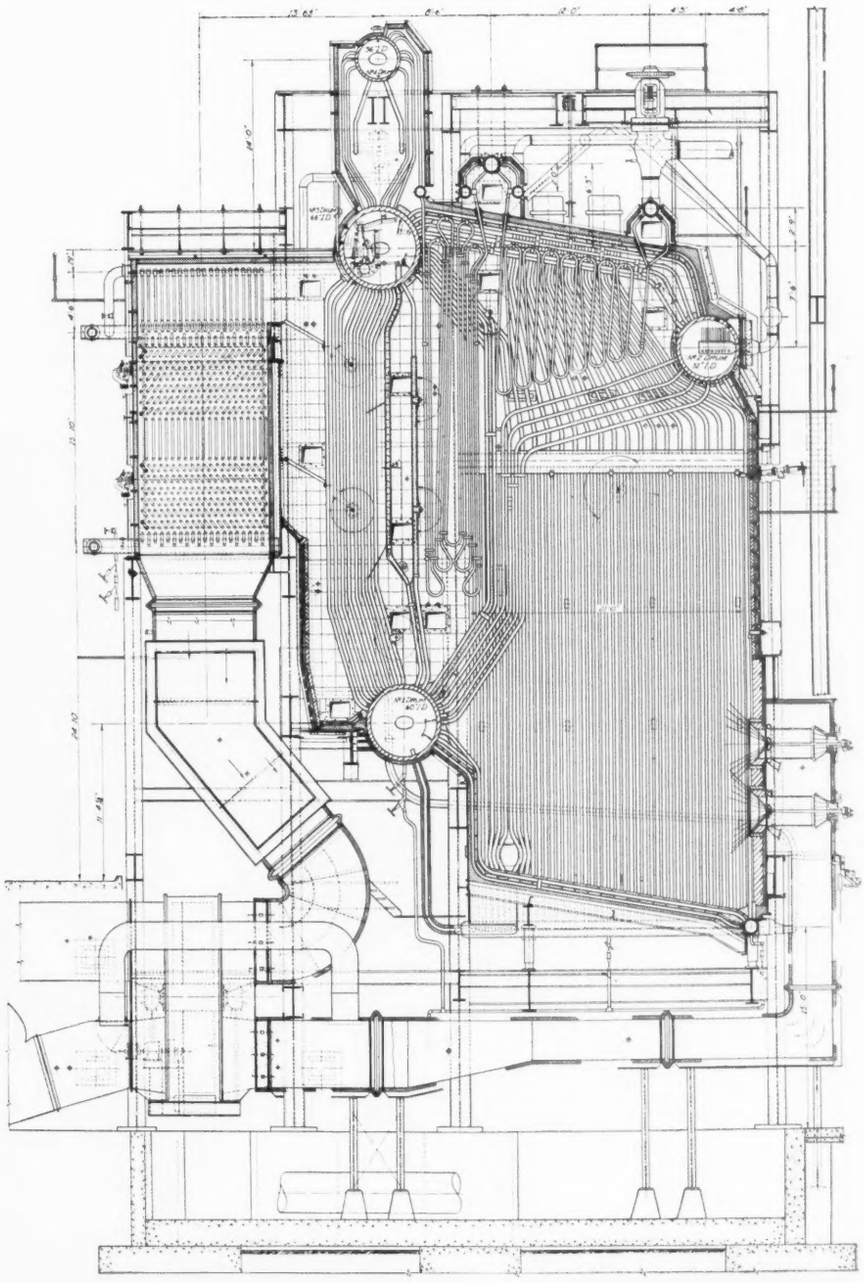
Pennsylvania Edison Co., Williamsburg, Penna.
Houston Lighting & Power Co., Houston, Texas
Carolina Power & Light Co., Cape Fear, N. C.
Northwestern Public Service Co., Aberdeen, S. D.
City of Taunton, Mass.
Southern Indiana Gas & Elec. Co., Evansville, Ind.
Union Electric Co. of Illinois, Venice, Ill.
Union Electric Co. of Missouri, St. Louis, Mo.
Lake Superior District Power Co., Ashland, Wis.
Western Electric Co-operative, Cyril, Okla.
Central Ohio Light & Power Co., Bluffton, Ohio
Central Illinois Light Co., Peoria, Ill.
Union Public Service Co., Canby, Minn.
Natrona Power & Light Co., Natrona, Pa.

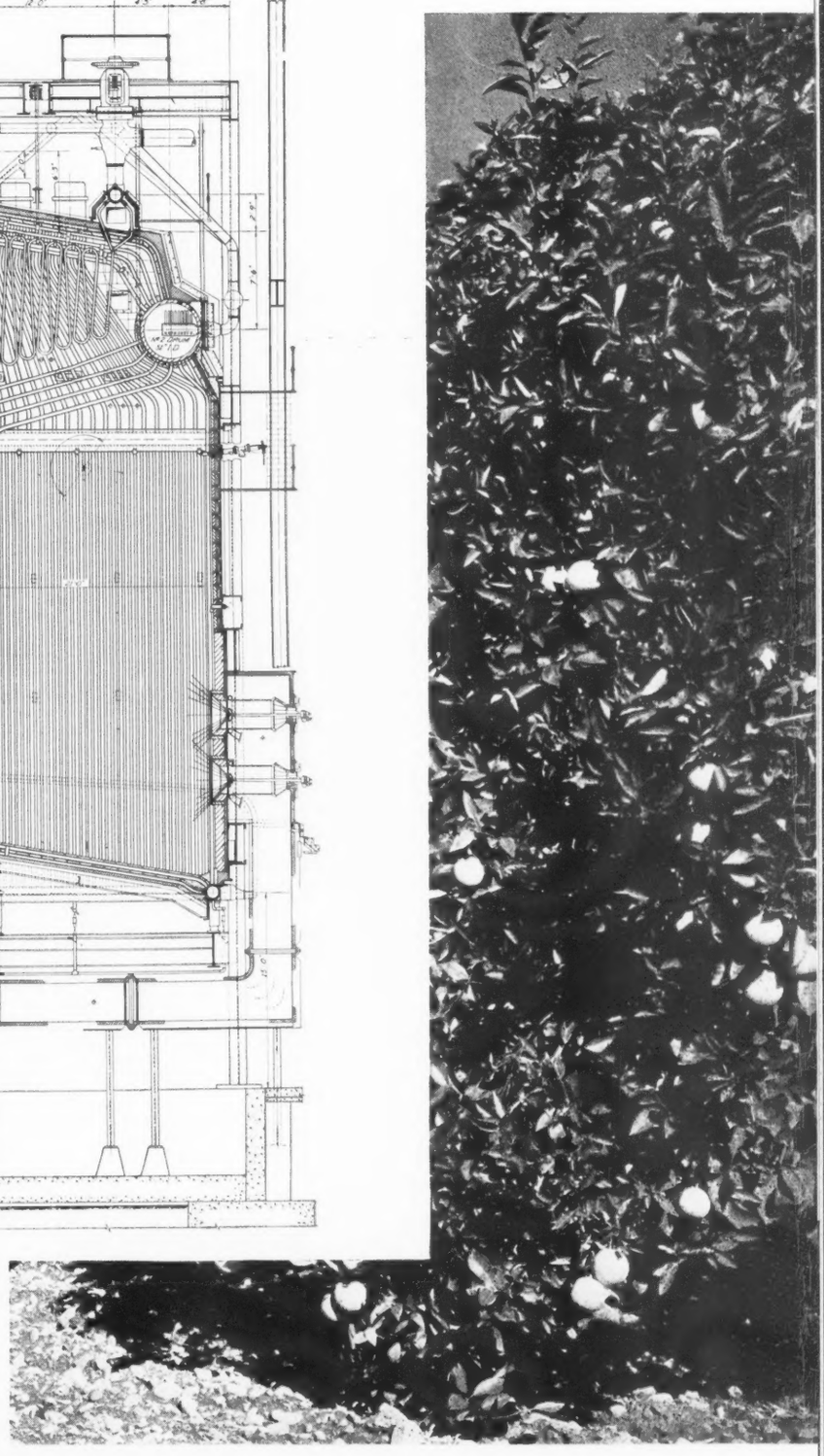


LARGE FLORIDA PUBLIC UTILITY
300,000 lbs./hr. 1025 lbs. pressure—905° F. Steam. Oil Fired Riley Steam Generating Unit. Efficiency—87.7% @ 300,000 lbs./hr.

It will pay you to visit modern Riley Installations

but both have selected Riley Steam Generating Units





CITY OF LOS ANGELES, CALIFORNIA
Harbor Steam Plant
675,000 lbs./hr. 1091 lbs. Pressure. 915° F Steam Oil and Gas Fired Riley Steam Generating Unit Efficiency — 86.1% @ 570,000 lbs./hr.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs.

RILEY

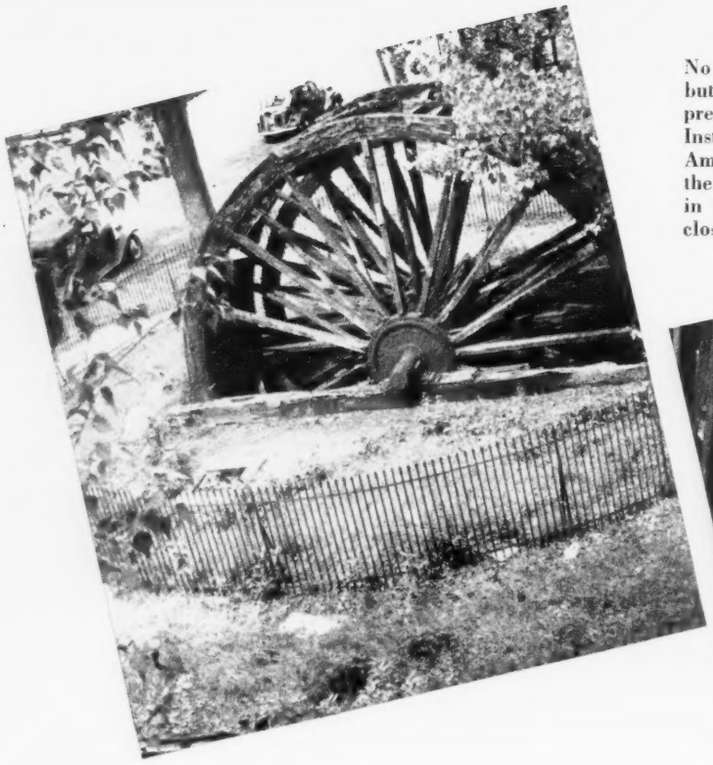
STOKER CORPORATION, Worcester, Mass.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma
Baltimore St. Louis Cincinnati Houston Chicago Milwaukee Denver
Memphis St. Paul Kansas City Los Angeles Atlanta New Orleans

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS
AIR HEATERS • ECONOMIZERS • WATER-COOLED FURNACES
STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment



No traces remain of Scovill's early water-power developments but the waterways themselves. However, this overshot wheel, preserved in Waterbury's Hamilton Park, typifies the period. Installed in 1846 by the Waterbury Brass Co, predecessor of the American Brass Co, this wheel powered rolls in what was then the country's largest brass mill. The veteran last saw service in 1905 when a production emergency followed a fire. The closeup view shows the interesting driving-gear construction

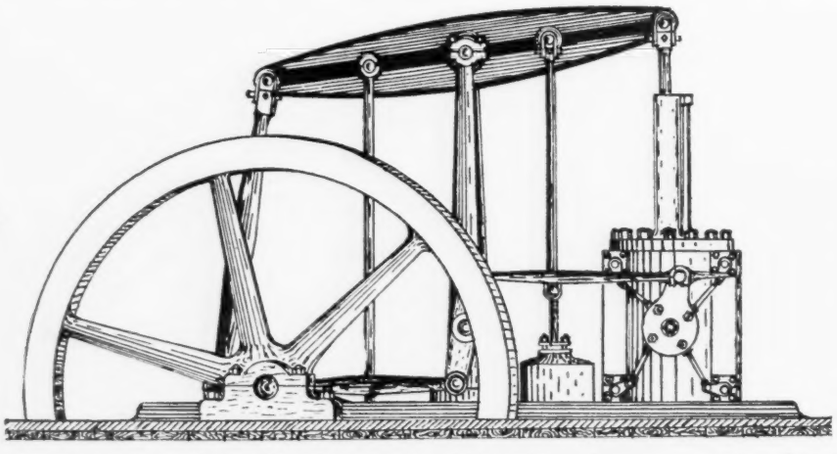
From "Horse" Power to High-Pressure Steam

Scovill's 139-year record spans the entire life-history of industrial-power development in New England

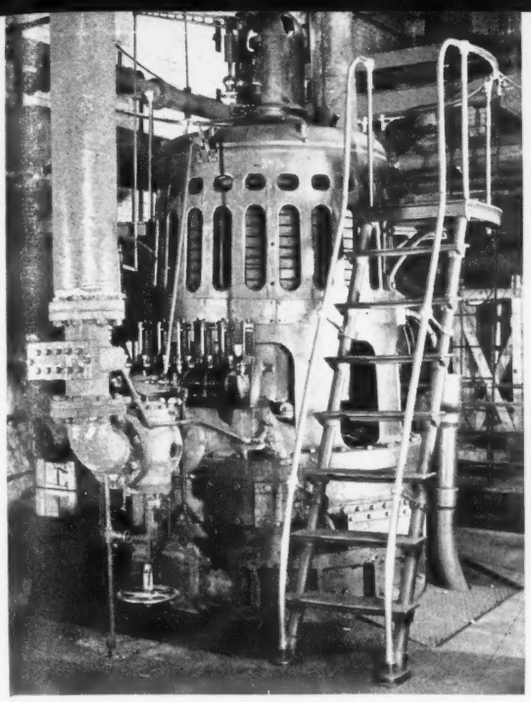
▶ Since 1802, the Scovill Mfg. Co, Waterbury, Conn., has generated its own power. Their progress from horse-turned mills, to water power, to steam engines and to modern electric generation is the story of industrial power in the Naugatuck valley and in the whole of industrial New England.

When the manufacture of brass buttons began in 1802, Waterbury had been a center of the infant brass industry for just over 50 years. In a dwelling house on S Main Street, horses slowly turned the 2-in. finishing rolls that formed the major equipment of the first Scovill factory; here was literal "horse" power.

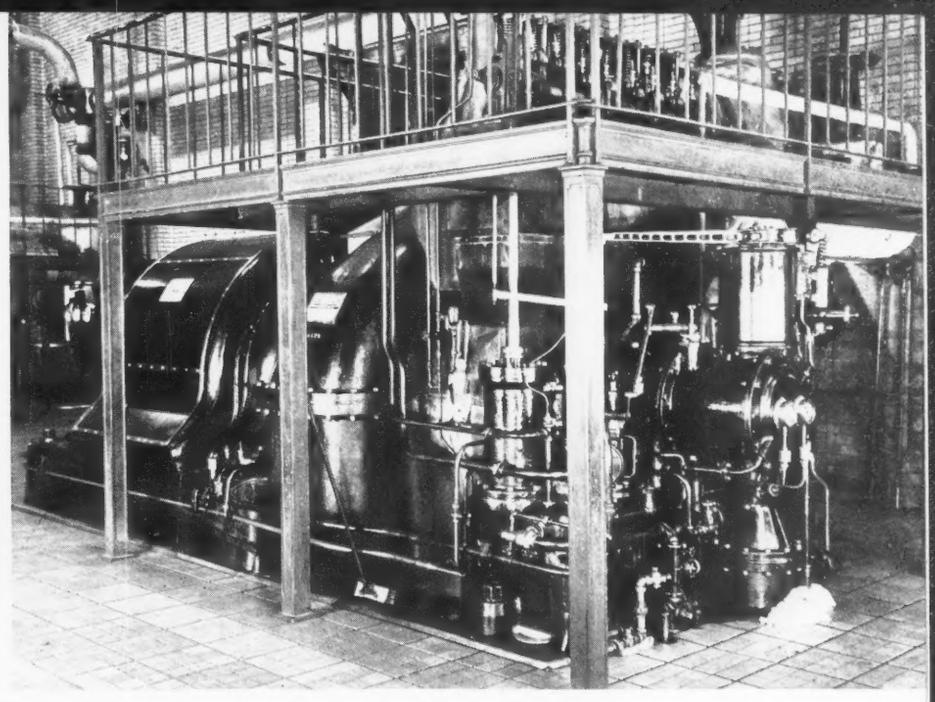
But the early history of New England industry is a history of waterways and waterwheels. Manufacturing followed the streams, the one dependable power source. In 1835, Scovill had two undershot wheels capable of turning out 25 hp each; these were supplied by damming the Mad River. By 1839, demand for power had outgrown supply and one of the 25-hp units was replaced by a breast wheel which, with its 12-ft face and 25-ft diameter, could produce 150 hp. Thus started the cycle that has been repeated constantly: new equipment, load growth, more new equipment. Many times thereafter the power problem would be "solved" and an equal number of times the march of events would bring new demands and new problems to be solved. In 1850, construction of a general novelty shop brought demands for power not easily available from the existing water supply, particularly during dry seasons. Scovill's first steam engine, "Sally Ann," a 125-hp vertical Woodruff and Beach unit, with corliss valve gear, went into operation in 1852. The day of exclusive water power passed; although waterwheels would turn for another sixty years, the use of direct-drive steam en-



"Sally Ann", a vertical walking-beam engine with corliss valve gear, contributed 125 hp to Scovill's power setup for 30 years after its installation in 1852



This 500-kw vertical unit, bought in 1904 when the turbine-generator was in its infancy, still stands ready to produce in any emergency



Installed in 1916, this 3500-kw 250-lb extraction condensing unit typifies the industrial-power turbine of 25 years ago. Taking up somewhat less space than "Sally Ann" it has about 38 times the old engine's capacity

gines located in various parts of the mill soon grew to dominate the picture.

Further expansion of power facilities took place in 1866. Raising the canal and making the 150-hp wheel overshot increased its output to 200 hp. A 24-in. water turbine installed in the canal and an extension to the rolling-mill line shaft supplied the new button shop (1870), and the original 25-hp undershot wheel was sold. The Chestnut Hill reservoir, built in 1869, stabilized the water supply, adding 100 potential horsepower in dry seasons. Again the power problem seemed solved and President Kingsbury estimated that water power alone would be adequate to the future needs of the company.

Further Expansion

Yet in 1880, a 150-hp engine went into operation in the Rolling Mill and in '81 the old overshot wheel was dismantled to be replaced by a 36-in. water turbine served by a new branch conduit from the canal. This unit was removed in 1904 and the last phase of water-power development began in 1907 with installation of a water turbine driving a 500-kw generator, which ran until 1912. "Sally Ann" passed out of service in 1883, after 30 years of continuous service, and in the same year two 300-hp Harris-Corliss engines were installed, to be followed in 1887 by a 400-hp tandem unit, and in succeeding years by two 100-kw and one 80-kw engine. Last of the long line of steam engines for direct-power drive was a veritable giant, a 1000-hp, 125-rpm, vertical, cross-compound Southwark engine, with 25- and 50-in. cylinders and a 36-in. stroke, installed in 1900.

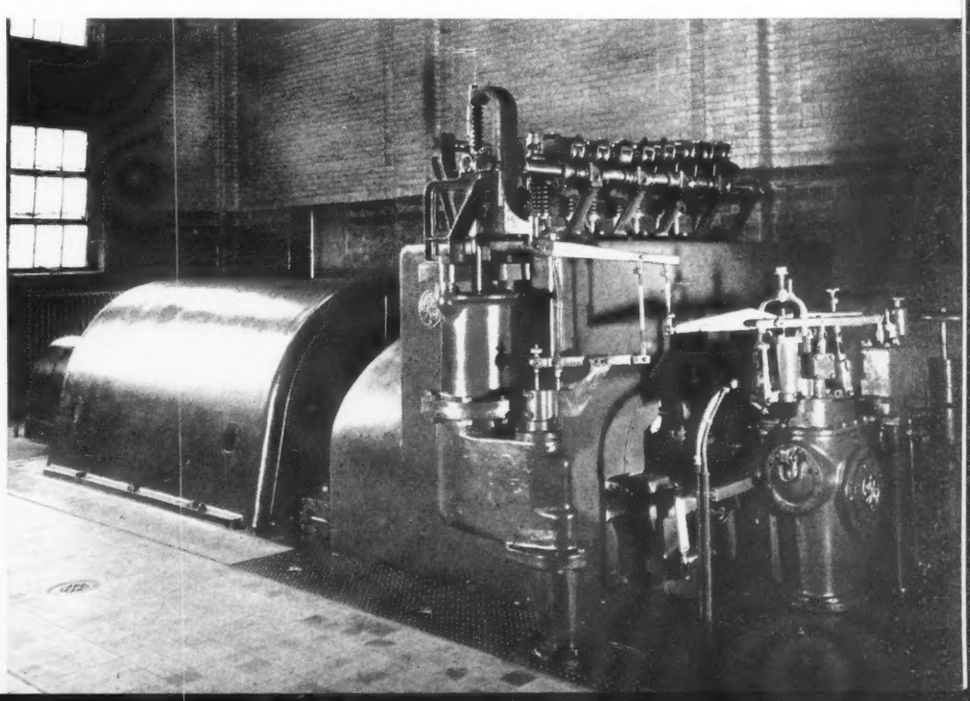
At its peak the individual steam engine was fated to go the way of water power, as electric generation came to the fore and what might be called the "modern" period began. In 1900, a 200-rpm, 250-kw tandem-compound Ball & Wood engine generator went into the new West Power House, to be duplicated in 1902.

Steam turbines were still relatively new when Scovill bought its first, a 500-kw vertical unit in 1904. The order on the General Electric Co contained the following clause: "The turbine to be the most economical, efficient and durable apparatus you can make; the decision as to type (2-stage or 4-stage) to be made after completion of running tests to be made on the new 500-kw, 4-stage turbine in your Testing Dept." Another 500-kw vertical followed in 1909 and a 750-kw horizontal unit went into service in 1911.

From these 150-lb units to the present, it is possible to trace the history of improvements in the industrial turbine-generator. One of the 500-kw units still serves as standby and can be compared with the 3500-kw, 250-lb units installed in 1916 and 1919, with the 3000-kw, 250-lb bleeding-condensing "top" added in 1929, and with the high-pressure topping unit of today.

This article condenses the complete history which appeared in the *Scovill Bulletin* of May-June 1922, made available to POWER through the courtesy of E H Davis. We also wish to acknowledge the cooperation of Miss E M Madden, Librarian, American Brass Co.

Latest addition to Scovill's long line of turbines and typical of today's topping practice, this 5000-kw 650-lb 750-F unit continues the trend to more kilowatts in less space



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Save TIME
Save MANPOWER
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ARMSTRONG TRAPS SAVE FUEL. Armstrong traps have tight-closing valves. There is no blow-thru of live steam under any load condition. You get full heat value out of every pound of steam.
ARMSTRONG TRAPS SAVE TIME. By getting rid of both air and condensate in a hurry, Armstrong traps enable you to keep equipment up to full capacity all the time. They help you hold full steam pressure in every chest, coil and jacket. They protect you against having excessive back-pressure build up in return lines.
ARMSTRONG TRAPS SAVE MANPOWER. Maintenance men in most plants have plenty to do without spending a lot of time repairing traps. Take advantage of Armstrong's trouble-free performance. Put an end to expensive maintenance. Use Armstrong traps for all jobs. Information and recommendations on request.
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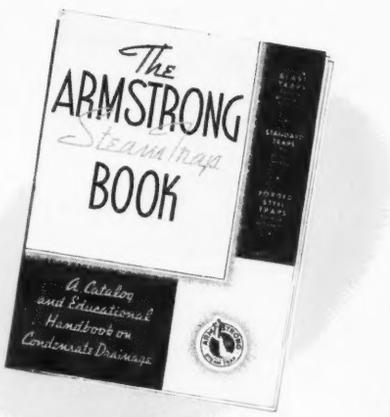


ASK FOR A COPY OF THE ARMSTRONG STEAM TRAP BOOK

THOUSANDS of engineers use this book to get all information needed to handle ordinary piping, heating, and drainage engineering jobs. It contains a wealth of tables, charts, curves, diagrams, etc. We will be glad to send you a copy without obligation.

SEE OUR CATALOG IN SWEET'S

Incorporating

the operating principle that gives you everything you want in a steam trap:

1. Top view shows trap when first installed. Steam off. Bucket down. Valve open. Inlet at left, outlet at right.

2. When steam is turned on, water fills body. Excess water escapes through orifice until . . .

3. Steam reaches trap and fills bucket, which floats and closes orifice.

4. Inflow of more condensate displaces steam in inlet to trap. Steam in the inverted bucket condenses. Bucket loses buoyancy, pulls on valve lever.

5. When weight of bucket times leverage equals pressure on valve, trap opens. Air, carried in with steam, passes up through small vent in top of inverted bucket and escapes through valve orifice.

TRAPS

Available in side inlet or bottom inlet styles

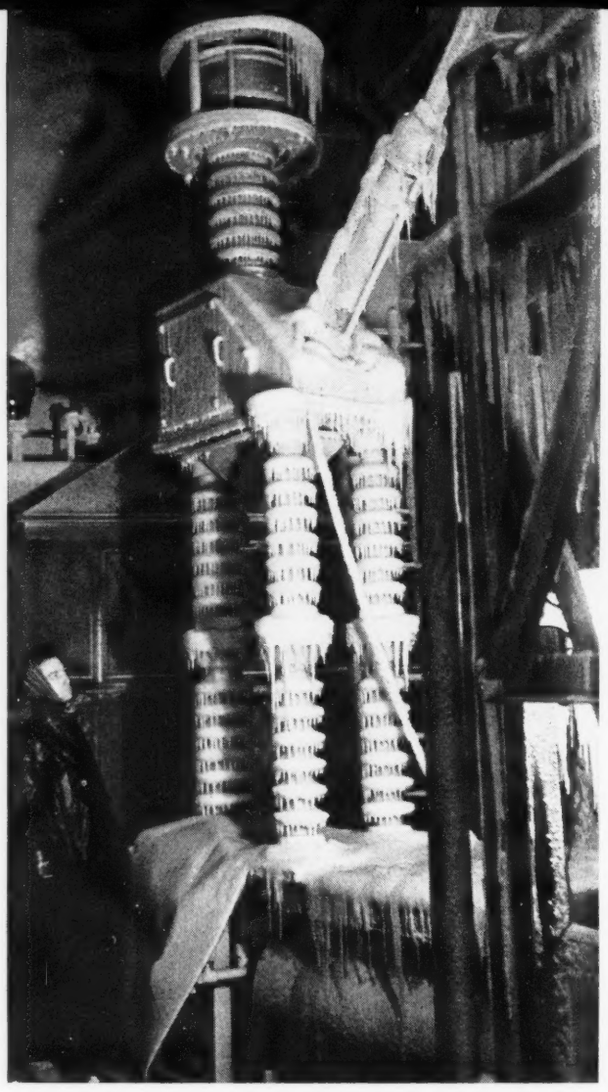
A compressed-air circuit breaker coated with icicles that formed when water was sprayed on the apparatus is shown here just before being tested

Circuit-Breaker Igloo

▶ CIRCUIT BREAKERS are now being tested under actual service conditions in the giant "igloo" more than a thousand times the size of a household refrigerator. With outside temperature 90 F, an outdoor-type air-blast breaker was set up and tested in the igloo at sub-zero temperatures. The first series of tests was made at approximately 20 F below zero to find an efficient and satisfactory moisture trap. The next stage of the test was to introduce rain and note the effect of ice formation upon the breaker disconnect switch. To accomplish this, a fine mist of water was sprayed and blown on the disconnect, the interrupter, and the seals of the mechanism housing. After ice was formed the breaker was operated. This test was made on three successive days and not once did the breaker fail to operate properly.

Refrigeration is accomplished by continually recirculating the inside air through the coils of an ammonia refrigeration unit. Liquid ammonia circulating in pipes absorbs the heat and turns into gas which flows back to the compressor to be changed again into liquid ammonia.

The Westinghouse "winter maker" in which these breakers are cold-tested is a brick building 12 ft wide, 31 ft long and 24 ft high, containing 8928 cu ft. The door, largest refrigerator door in the United States, weighs 4000 lb and is insulated with 6 in. of cork beneath galvanized iron. Rubber and felt insulation prevent heat from coming in around the bottom of the door. The walls and ceiling of the igloo are covered with 6 in. of cork and 0.5 in. of cement plastic. The concrete floor base is topped with 6 in. of cork and another coating of concrete 2 in. thick. Two "peep hole" windows, containing six layers of glass, make it possible for engineers to look in without stepping into 20-F-below-zero weather.



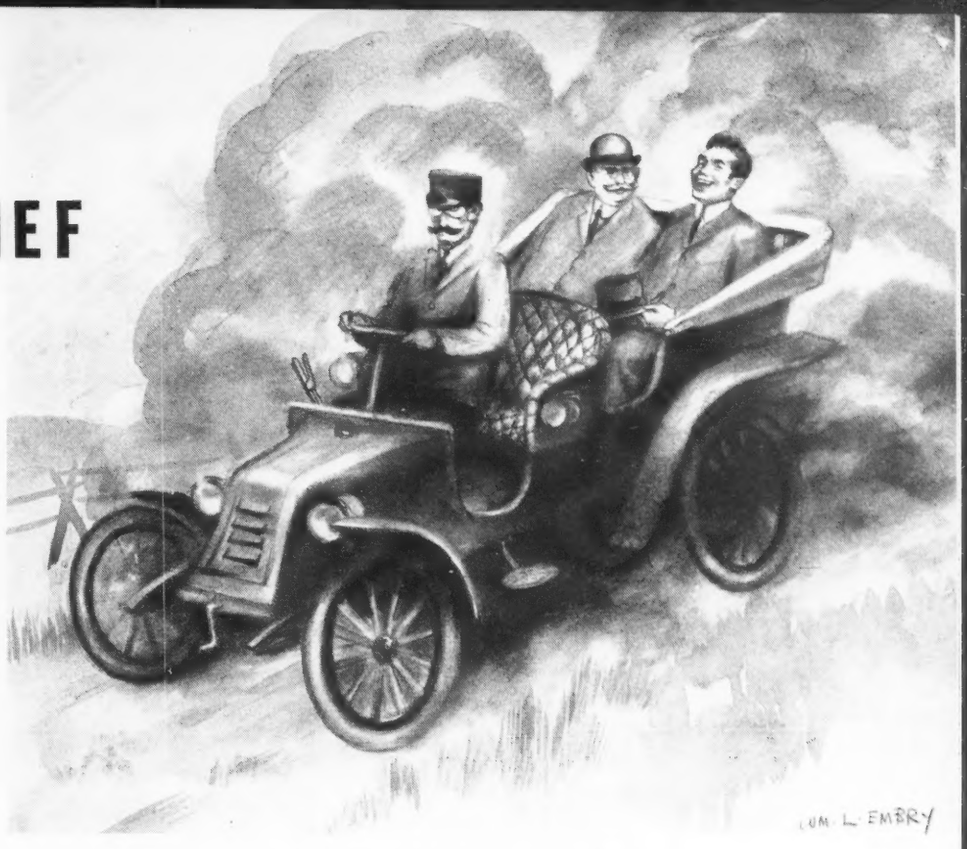
Protected against sub-zero cold, this engineer has just stepped out of 90-F heat into a cold-test laboratory to watch the performance of a breaker coated with icicles

Temperatures dipping down to 20 F below zero provide winter tests in summer for apparatus at the East Pittsburgh Works of the Westinghouse Elec & Mfg Co

THE OLD CHIEF

XII—Very Controllable Losses

Twelfth in a series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario. Writing of the inspiration of the past, he has captured much of the human side of engineering that lies beneath the maze of power-plant costs and the wavy lines on paper disks



Coming back from that job I had my first automobile ride

▶ DURING THE SUMMER OF 1914, just prior to the opening of that war in Europe, which, if memory serves me right, was to end all wars, the Old Chief had placed upon his broad shoulders the reorganization, care and management of two additional plants situated in nearby towns. These plants, together with their factories, had been acquired (or wished-on) the good firm that we worked for, by means and virtue of a control-merger, merger purchase or some other form of magic bookkeeping, whereby we handled production costs.

Both plants were approximately 300 hp and in each case the men who designed the buildings had laid out suitable office space, loading and unloading platforms, workshops, etc., and then discovered that there remained a "dog-leg" shaped corner of the building, into which the engine and compressor could be squeezed. The boiler rooms were holes in the ground with rusty iron smoke stacks sticking out of them. In the buildings we first surveyed there was a smart and spacious administrative building and show room beside the factory, which was very attractive, but when we came to inspect the boilers we found them very "wackey" in their setting, standing on decrepit piers and leaning towards each other, as if for mutual help and support in their old age. As the nearby river was in the habit of flooding this boiler room we decided to re-set them on level ground.

Herein let me record an act of poetic justice that may serve as a rebuke to all architects wherever they are or whatever they may be doing.—*We moved the boilers and engine room equipment into the ornate office building and squeezed the office stuff into the old engine room.* What a grand and glorious feeling it afforded us to do so! In the other plant that we had acquired we made only one big alteration and that was to double the size of the engine room, and set up a new cross-compound engine.

By reason of unusual settling of the foundations, and by further reason of unusually dumb steam-fitting, the various items in this power plant closely resembled the diagrams that were published in POWER under the heading of "What's Wrong With This Picture?" We were forced to jack up and alter the drip slope on almost every steam line, as we found bucket traps hooked up in what might be termed politely as "ankle for elbow."

We found that for years the heating system had dripped to the sewer, possibly due to the fact that the above mentioned traps did not work very well. But the prize discovery of all was an antiquated half-inch pipe devoid of any shut-off valve, leading from the cold-water main to the bottom of a catch-basin. It evidently served to drain the system during a lay-off and was forgotten or never discovered when the plant was re-started. We found a medium-pressure steam line that wandered up stairs and down stairs doing nothing in particular, except getting "water on the brain." We finally traced it to within six feet of its starting point, where it was used in a pre-dryer.

This item by the way, was adorned with a thermometer which registered 200 degrees F with the steam off.

The Old Chief talked with the men who had been running the plant and discovered that their previous experience had been restricted to a limited period of firing brick kilns and threshing outfits. The company had evidently had difficulty in keeping engine men and firemen on the job and had adopted a policy of employing only those who, by some mental or physical derangement, would be most likely to stick with the job and not bother the manager about costly repairs, higher wages or other nonsense of that kind. We spent weeks plugging leaks and eliminating death traps until the job was safe to operate.

Coming back from that job I had my first automobile ride. Our general manager had sent his chauffeur in his new imported Renault touring car to bring us to town. As we drove back the Old Chief remarked on the large amounts of money that were being spent in attempts to raise and salvage sunken ships all over the seven seas, and gave it as his considered opinion that much larger profits would result if someone would float a company to go around plants like the one we had just left and do some dry-land salvage work. Warming up to the subject, he added, "I wish to goodness there were a dry-land Board of Trade Commission to convict and punish the persons really responsible."

Governing the Pickwick Landing Hydro Turbines

J J Ring, hydraulic engineer, Allis-Chalmers Mfg Co, outlines the problem involved in governing the 55,000-hp Kaplan turbines in the Pickwick Landing plant and explains how the governors function to control turbine speed and to position the runner vanes to maintain high operating efficiency

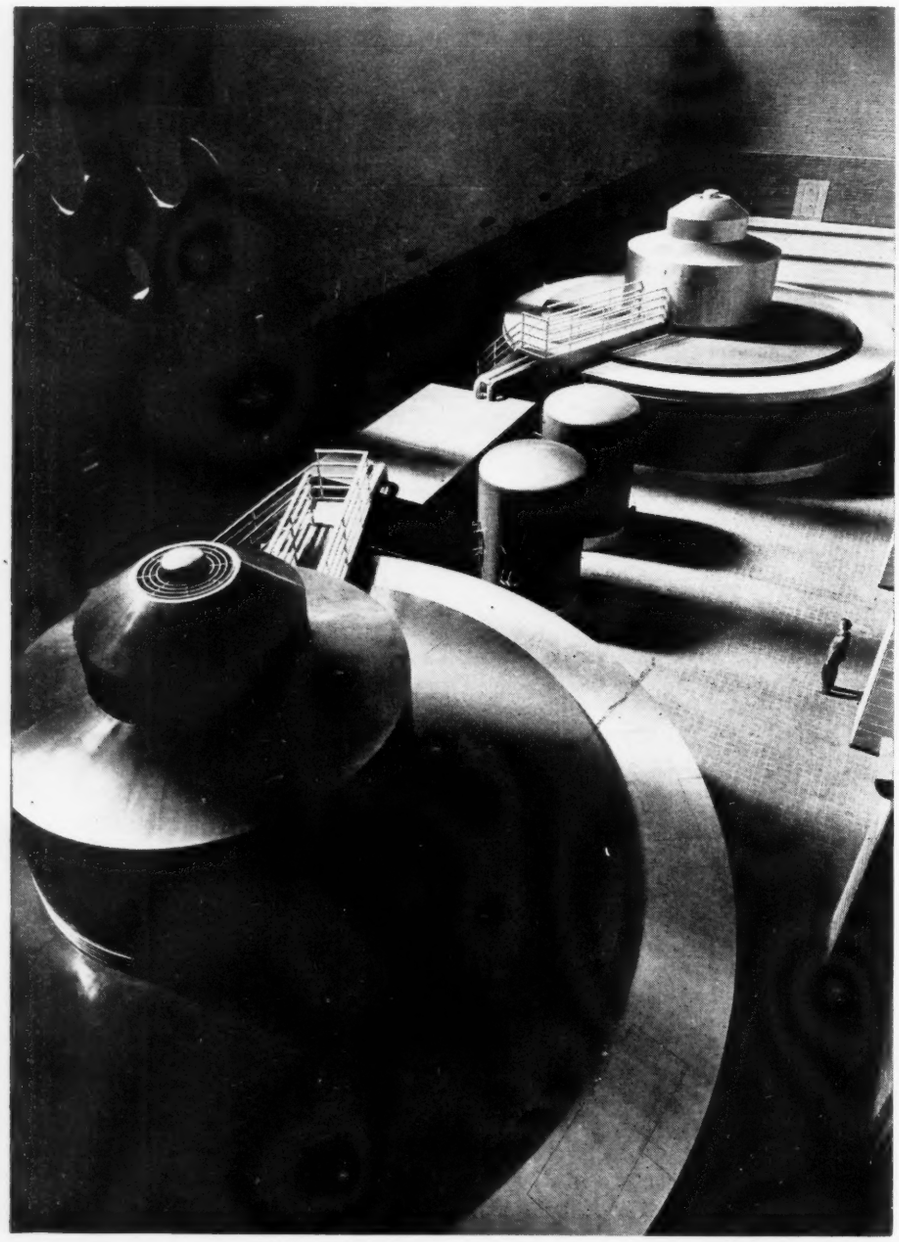


Fig. 1—Governor cabinet with the two pressure-oil tanks located between the generators

► PICKWICK LANDING PLANT of the Tennessee Valley Authority on the Tennessee River has two Kaplan hydro turbines installed and two are on order. Each connects to a 40,000-kva, 0.90-pf generator, operates at 81.8 rpm and is rated 48,000 hp under a 43-ft head. Normal head is 56 ft, but generator capacity limits turbine output to 55,000 hp, even though the units can develop 68,000 hp under this head and 76,000 hp at the maximum head of 59 ft. These are among the largest of this type in the world both in power output and physical dimensions and present some interesting problems in speed governing.

Description of Turbines

For those who may not be familiar with this type of unit a brief description is given. Fig. 3 shows a cross section through one turbine. The propeller-type runner has six vanes.

Each is supported in two bearings *B* in the runner hub and connects by a short crank and link to a crosshead *H*. This crosshead connects by a rod in the center of the turbine shaft to the piston of a servomotor between the flanges on the turbine and generator shafts. The piston of this servomotor, which is 67 in. in diameter and has a 9⅛-in. stroke, positions the runner vanes when the load changes, thereby maintaining high efficiency over a wide operating range of the turbine.

Water to each turbine is controlled by 24 wicket gates or guide vanes 4 ft wide by 9 ft 4 in. high, weighing 6,000 lb each and set in a 28-ft 2-in. circle, as shown in Figs. 2 and 3. The top ends of the guide-vane shafts are fixed to crank arms that connect by links to an operating or shifting ring, Fig. 2. This ring connects to two servomotors under governor control that turn it through a small arc to open or close the guide vanes.

To move the guide vanes from full open to full closed position at 59-ft head requires about 500,000 ft lb of energy which must be supplied in 8 sec or less. Even a tiny change in guide-vane position requires movement of 150 tons of steel. In addition to the energy required to move the guide vanes,

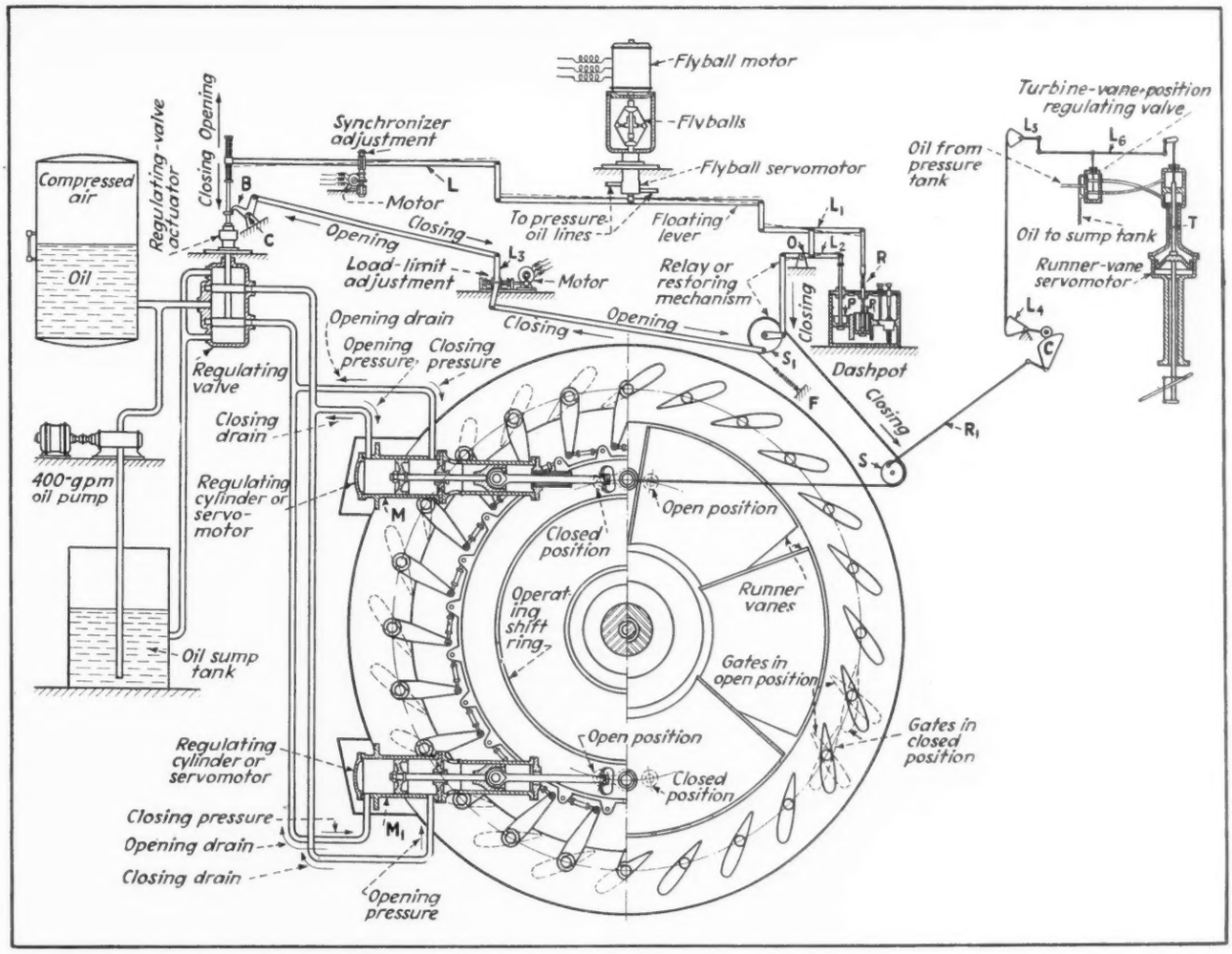


Fig. 2—Diagram of the governing system and its connections to the turbine gates

almost twice as much, 800,000 ft lb. is needed to move the runner vanes.

Energy to move the guide and runner vanes is supplied from two oil-pressure tanks, 8 ft in diameter by 11 ft high. The upper part of the tank is filled with compressed air at 275 to 300 lb pressure. Oil pressure is maintained by two 400-gpm screw-type pumps, each driven by a 100-hp motor. Exhaust oil from the servomotor drains into a sump tank. From there the pumps return it to the pressure tanks as required to maintain pressure.

Practically all parts of the governing systems for the two units, with the exception of the servomotors and pressure tanks, are mounted in a cabinet. Fig. 4. This assembly is 21.5 ft long, 11.5 ft wide and 8.5 ft high. In this cabinet the oil sump forms the base on which the governing mechanisms and the oil pumps are mounted.

On the panels forming the front of the cabinet, gages, meters, handwheels and other devices for manual control of the two turbines and their accessories are mounted. By turning a control handle on the governor panels, a turbine may be started, brought up to speed, synchronized and made to carry a predetermined head. Turning this handle in the opposite direction closes the turbine guide vanes and applies brakes to the generator to stop the unit. If desired, the turbine can be held at synchronous speed, with no-load guide-vane opening.

Safety devices are provided in the governor systems so that hot bearings, governor-oil-pressure failure, bearing-oil-pressure failure, and generator troubles will automatically stop the turbine. For other emergencies, the safety devices will close the guide vanes to no-load opening. When the governor flyballs are either mechanically or electrically driven from the main shaft of the unit they do not respond to a load change until the shaft-speed changes. When the flyballs are driven by a synchronous motor direct-connected to the

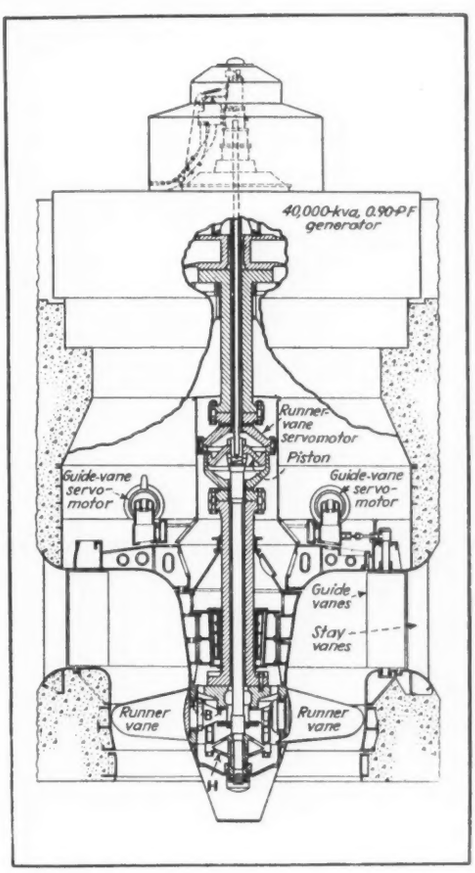


Fig. 3—The runner has six vanes, each supported in two bearings, and can be positioned by the governor for best operating efficiency at different load.

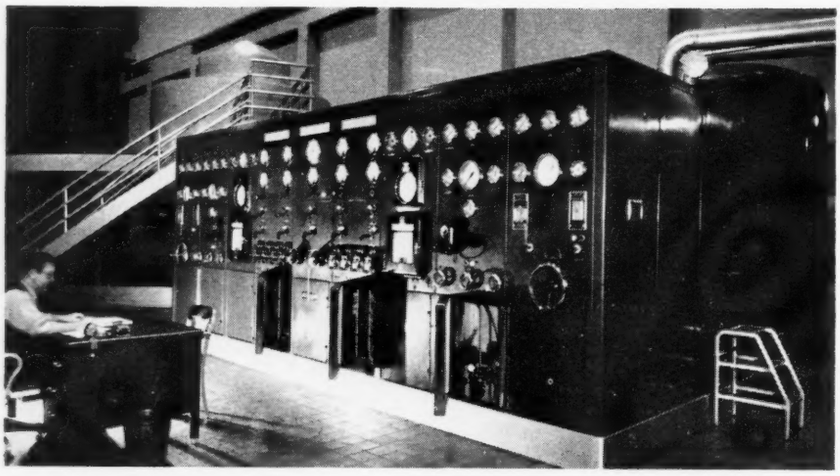


Fig. 4—Practically all parts of the governing systems for the two units, with the exception of the servomotors and pressure-oil tanks, are assembled in this cabinet

main generator leads, the motor will respond to system frequency just as soon as a load change occurs, and not until after the speed changes, as in the former example. In this way a very sensitive flyball will gain some time in response to load changes which may be very appreciable in speed regulation.

There are some electrical disadvantages of this flyball drive, but these can all be taken care of very easily by protective devices. Anyway, these disadvantages are usually more academic than actual difficulties. This is especially true in practically all modern governors because the flyballs do not rise off the lower stop until the turbine has come up to at least 85% of normal speed. Until the flyballs do "pick up," all the governor can do is to open the turbine gates.

Pickwick governor flyballs are driven by direct-connected synchronous motors connected to transformers on the generator leads. On starting, the guide vanes cannot be opened beyond the normal-speed setting, until the flyballs "pick up" and are controlling the unit. If the voltage drops below a preset value, or turbine speed rises above 105% of normal, the governor brings the gates to normal-speed no-load opening. This is done independently of all electrical conditions prevailing in the generator or system.

Satisfactory operation of a relay governor is dependent on the action and adjustment of the relay or restoring mechanism. This mechanism "relays" movement of the guide vanes back to the governor and returns the valves that control the oil to the servomotors to mid-position. In this way, movement of the guide vanes is stopped before they move too far, but not before they have moved far enough to bring the speed back to normal. Adjustment of this action determines the governor's effectiveness and stability. Many of the conditions affecting operation cannot be determined before installation, so the relay mechanism must be designed for wide adjustment and must have a minimum of lost motion in its parts.

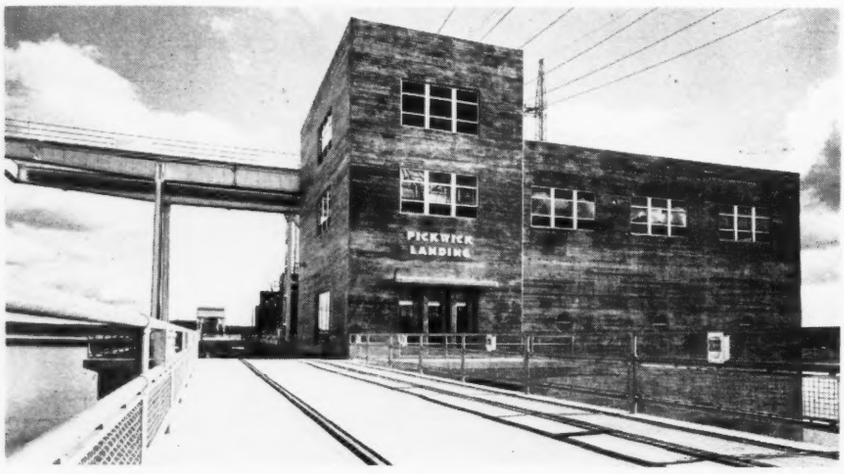


Fig. 5—Pickwick Landing has two 55,000-hp 56-ft-head units and two more on order

Valves on the Pickwick units are all hydraulically balanced, and so designed as to require very little force to move them. They have microscopic laps and clearances so as to be sensitive to the movements of the flyballs caused by small speed changes.

Now, let's see how the governing system, Fig. 2, works. The flyballs connect to a pilot valve that controls the flow of pressure-oil to a small servomotor, the piston rod of which connects to the floating lever. At its left-hand end this lever connects by a link to a lever L pivoted in the synchronizer adjustment. The left-hand end of lever L connects to the regulating-valve pistons through the regulating-valve actuator. At its right-hand end the floating lever connects by a link to a lever L_1, which is part of the governor-restoring mechanism.

Assume that the turbine is operating under a steady load. Its gates will then be positioned to admit just sufficient water to the runner for this load condition. If the load decreases, the turbine speed and system frequency will tend to increase, which will cause an increase in the flyball speed. This action causes the flyballs to lift the pilot valve to admit pressure oil below the flyball servomotor piston. The floating lever is thus lifted a short distance and, through lever L lowers the piston in the regulating valve. The top edges of the two ports in this valve are uncovered. Pressure oil can now flow from the tank through the lower port into the right-hand end of turbine-gate servomotor M and into the left-hand end of servomotor M_1. The top port of the regulating valve opens a passage from the turbine-gate servomotors to the oil-sump tank.

Positioning of Gates

Oil applied to the servomotor pistons turns the shift ring counter-clockwise and the gates clockwise toward the closed position. To prevent the gates closing too far, the right-hand end of the floating lever connects through a link and lever L_1 to piston P_1 in a compensating dashpot. The outer end of the piston rod of servomotor M connects by a cable over sheaves S and S_1 to a spring fixed at F. A crank on sheave S_1 connects to lever L_2, which is pivoted at O and connects to piston P_2 in the compensating dashpot. This part of the governing system is known as the relay, or restoring mechanism.

As servomotor M moves to the left to close the gates, it turns sheave S_1 in a clockwise direction. This motion is transmitted through lever L_2 to move piston P upward, which applies oil

(*Continued on page* 142)

THE OPERATING ENGINEER

George Edwards
Advisory Editor

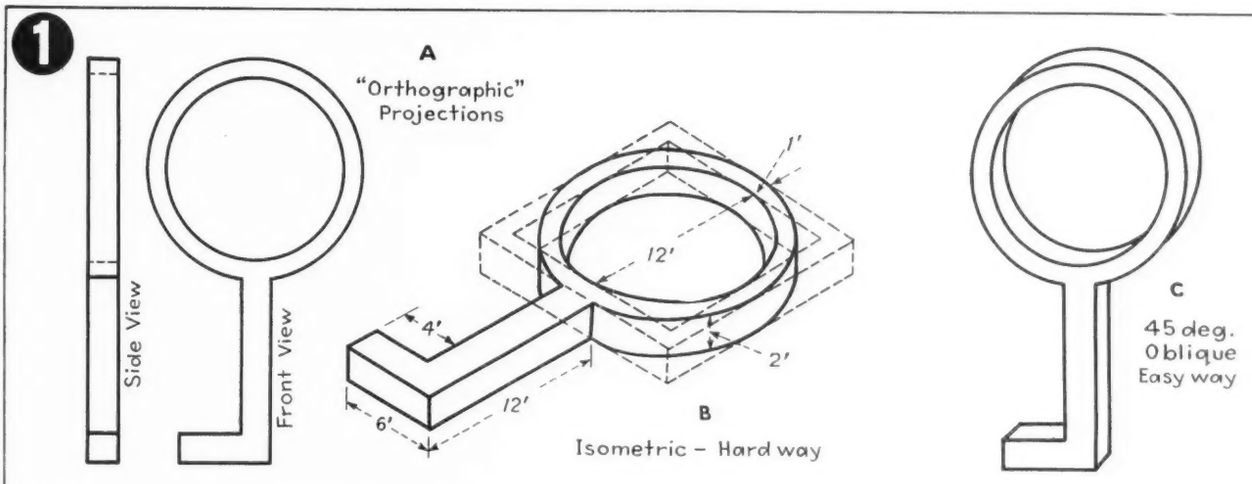
Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

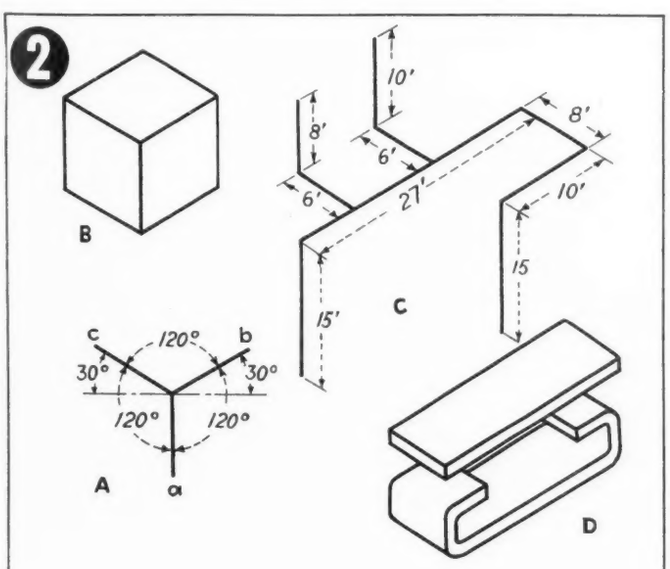
How to Sketch

By PHIL SWAIN

Step-by-step instructions for making "perspective" sketches by "45-degree oblique" system. They are easy to draw and can be understood by a mechanic who can't read blueprints



Machine part shown in orthographic projection (A) and in isometric (B). Isometric gives pleasing appearance but is hard to draw here because the circle must be shown as an ellipse drawn to touch the four sides of the square in middle of each side. In contrast, the 45-deg oblique projection C is easy to draw because circles here are shown as true circles



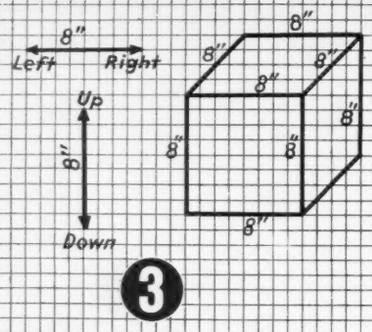
Isometric projection—a form of imitation perspective widely used by engineers. The three prime isometric directions are shown at A and applied to a cube at B. Other applications: C—piping layout; D—machine part. In isometrics the dimensions are laid out full scale along the three prime directions

EVERY WIDE-AWAKE ENGINEER uses drawings and sketches to fix on paper his ideas of machines and structures and to make them clear to others. Most commonly he uses ordinary plans, elevations and sections (technically known as "orthographic" projections) because they show the object square on and without any distortion of dimension or shape. The trouble with these orthographic projections is that they often don't "look like" the object presented.

At the other extreme you have photographs and true prospective sketches. Both look like the object pictured. Both show distant objects smaller than near objects. In both lines that are parallel in nature flow together to some distant "vanishing point."

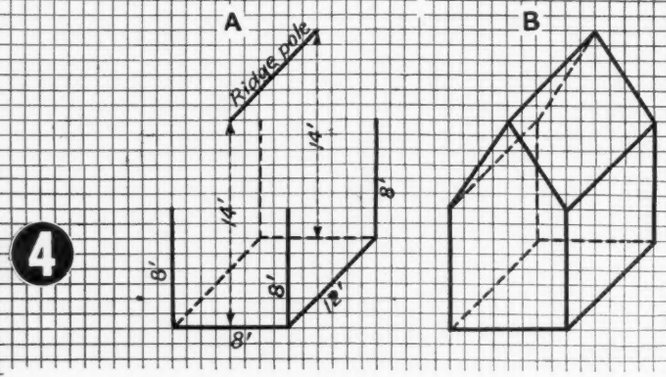
Perspective sketches have the great advantage of looking "natural." They can be understood by a non-technical man to whom a standard blueprint would be so much Greek. The disadvantage of true perspectives is the great labor required to produce them and the fact that dimensions cannot be scaled directly from them. True perspectives are used extensively by architects, but little by engineers.

Engineers, on the other hand, use several varieties of imitation perspective to give a similar pictorial effect without



3

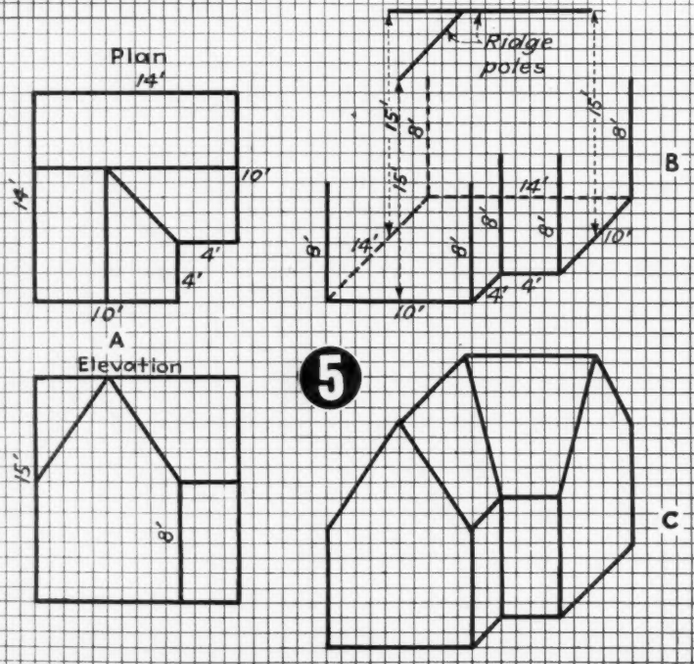
All 45-deg oblique systems show vertical lines as vertical full scale, left-right lines as horizontal, full scale. All show back-and-forth lines as 45 deg, but to various arbitrary scales. In this article we always measure the 45-deg line in terms of the number of squares crossed. Where one square is unity for vertical or left-right lines, the diagonal of one square counts two on the 45-deg lines. Eight-inch cube is drawn in 45-deg oblique. Note that the 45-deg lines cross four squares to represent a back-and-forth length of 8



4

Sketching a shack in 45-deg oblique:
A — Lay out ground floor; erect verticals and locate ridge pole
B — Connect corners to complete sketch

Sketching house
A — Connect corners to complete house (erase hidden lines)
B — Lay out floor in oblique; erect verticals; locate ridge poles
C — Plan and elevation



5

undue labor. Of these the two most important are "isometric" and "oblique." Isometric is illustrated in Fig. 2, *B* representing a cube with one corner turned toward the eye. Note that every line in the cube is either vertical or slanted 30 degrees from the horizontal —also that all lines are of equal length. This gives the key to the isometric system, more clearly shown at *A*. Vertical lines in the object are represented by vertical lines (like *a*). North-south lines are represented by lines parallel to *b* (slanting up 30 deg to the right) and east-west lines by lines parallel to *c* (slanting up 30 deg to the left).

In many machines, systems and structures most of the important lines can be made to fall in three systems: (1) verticals, (2) north-south lines, (3) east-west lines. If so, they can easily be reproduced in isometric or in a system to be described later.

Fig. 2 *C* shows how neatly a piping system may be shown to scale in isometric while *D* shows a machine part in this system. In these isometric sketches all three dimensions are laid out full scale. Isometrics may be conveniently drawn on special isometric plotting paper (sold by engineering stationery stores) or on plain paper, using a 30-deg triangle.

The Easiest System

While widely used, isometric is probably not the most convenient system for most engineering "perspective" sketches, particularly where some of the lines in the object are curved or of irregular shape. This becomes apparent in Fig. 1, where a simple shape is shown three ways: *A*—orthographic; *B*—isometric; *C*—"45-deg oblique." Obviously, the oblique is much easier to draw than the isometric because the isometric represents the circles by ellipses drawn within squares in the manner shown, whereas the circles in *C* are drawn true with a compass.

Because the 45-degree oblique is the most useful system, but not the best known, the rest of this article will be devoted to it in a slight modification of the form usually taught. With this system freehand sketches can be drawn roughly to scale on ordinary squared paper without using either scale or straight edge, although neater sketches can be made with the help of those gadgets and a 45-degree triangle.

Let's start this explanation with an object of rectangular shape, like a box. Imagine that one face of this object is turned toward you. This face should be drawn to scale in its true shape. To put it another way, all vertical lines in the object should be vertical in the sketch

and all left-right lines in the object should be horizontal in the sketch, both to scale.

That leaves only the back and forth lines (those that run to and from the observer) to be taken care of. These are drawn at 45 deg (slanted either right or left as convenient). The scale of the 45-deg line will be better understood from Fig. 3. If a square of the paper ruling is taken as unity for vertical lines and for left-right lines, the diagonal of a square may be taken as two units for the back-and-forth 45-deg lines. (This is a modification of the customary rule). Thus the width and height of the cube shown in Fig. 3 are each represented by the diagonal of four squares—(half of 8). This convention makes it possible to work on squared paper without a separate scale and gives a sufficiently true effect.

How to Sketch Fig. 4

Let's apply this system to build a shack on paper—8 ft x 12 ft ground plan, with eaves 8 ft from ground and ridge pole 14 ft above ground. First lay out the ground plan as shown in Fig. 4*A*. Note that the 8-ft width is laid out as 8 squares. The 12-ft depth is laid out as the diagonal of six squares. On the four corners erect the 4 vertical posts full scale (8 squares). Locate the front of the ridge pole 14 squares above the center of the front of the front sill and the back end of the ridge pole 14 ft above the center of the back sill.

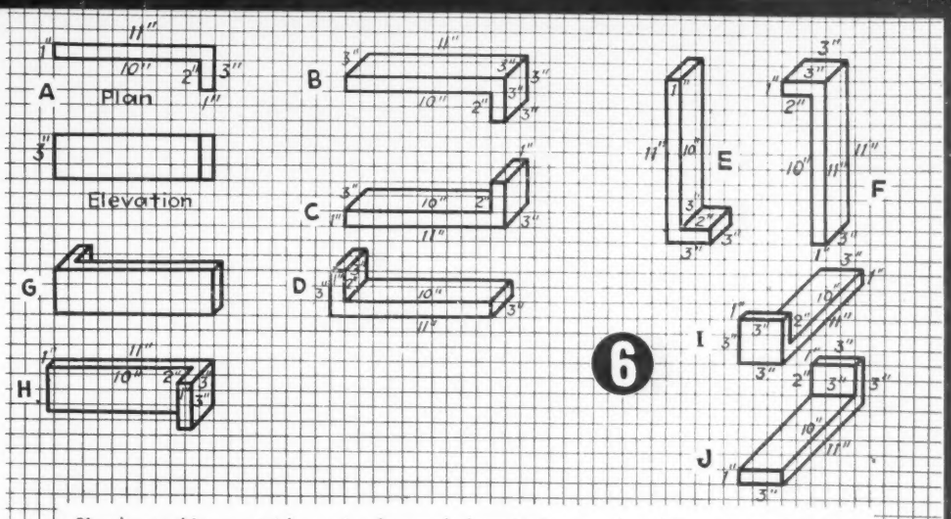
To complete the building, connect the corners, leaving hidden lines dotted, as at *B*, or erasing them entirely.

Now let's take something slightly more complicated—the house shown in plan and elevation in Fig. 5 *A*. In *B* the ground plan is drawn in 45-deg oblique. Where 10. 4 and 14 are left-right dimensions they are shown as that many squares. Where 14, 4 and 10 are shown as back-and-forth dimensions on 45-deg lines they are laid out as the diagonals of half that many squares. On the corners of the building are erected the 8-ft vertical posts, full scale. Ends of ridge poles are located 15 ft above centers of corresponding sills.

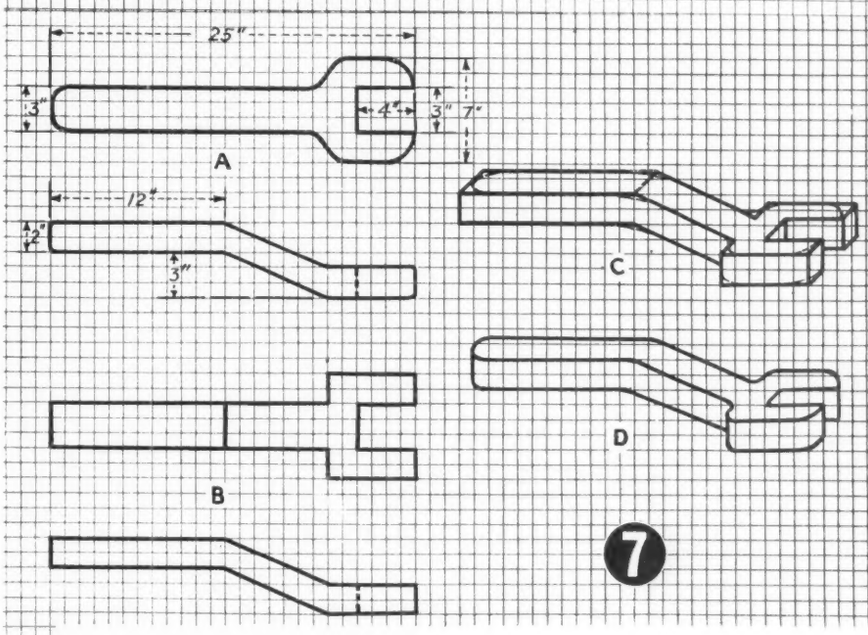
Connecting corners, and erasing hidden lines, we get the sketch *C*.

The reader who has followed the discussion thus far will see that this system of 45-deg oblique sketching is very easy as applied to simple architectural forms. This is equally true of its application to any machine part composed mostly of rectangular shapes.

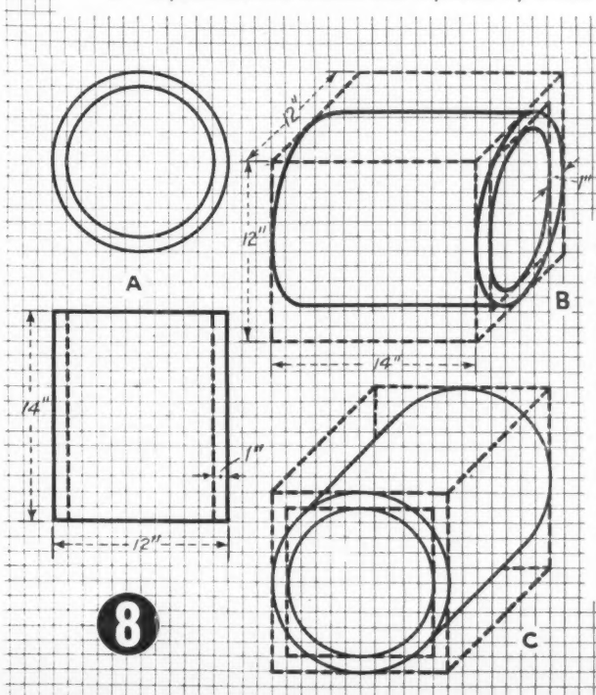
For example, consider the simple shape shown in Fig. 6 *A*. In *B* to *J* it is pictured nine different ways, all 45-



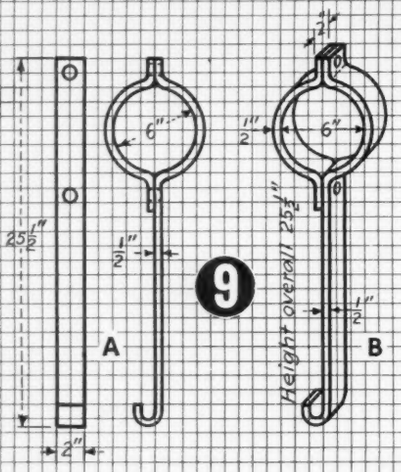
Simple machine part (shown in plan and elevation), reproduced in variety of 45-deg oblique projections. Of these *B, C, D, E, F* are easier to draw than *G, H, I, J*



Sketching an offset wrench
A — Orthographic plan and elevation
B — Same reduced to squared form to save labor
C — Squared form of *B* converted to 45-degree oblique. On this is drawn in dotted lines the curved outline
D — Square corners erased and replaced by curves



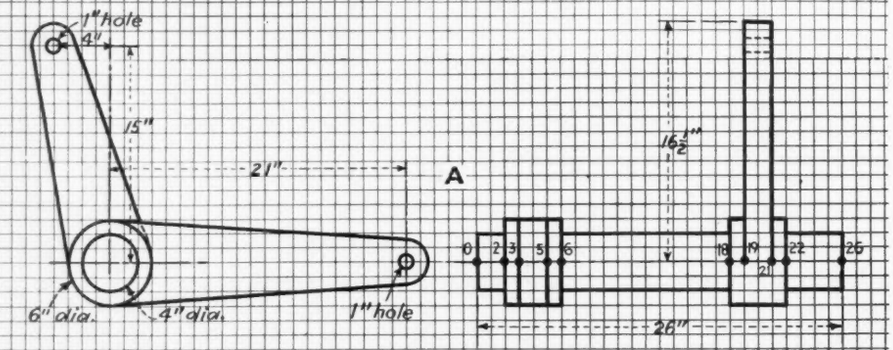
Hard and easy way to show circles:
A — Orthographic views of a bushing
B—Oblique sketch with circles shown as ellipses on side face (hard way)
C—Oblique sketch with circles shown as true circles on front face (easy way)
Note: In general, with 45-deg oblique, choose the most difficult face—(irregular, with circles, etc) as front face. It can then be drawn actual shape

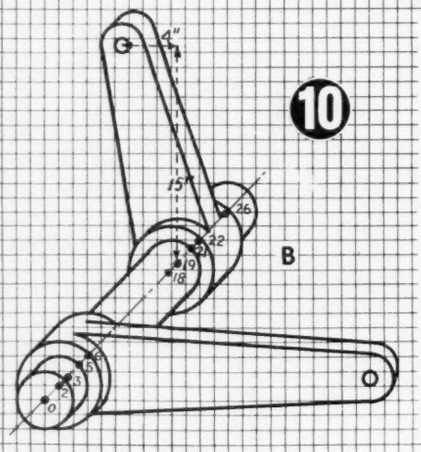


Pipe bracket:

A — Orthographic views

B — 45-deg oblique. Drawing looks difficult, but is easy because difficult side has been selected as front side and is copied directly from orthographic. From points on this a group of 45-deg lines are drawn, each crossing one square diagonally to represent a strap width of 2 inches. Back-side circles are drawn from centers that set back and right the diagonal of one square from centers of front circles





Bell-crank lever shows how to handle a difficult subject.

A — On center line of the orthographic projection locate centers of the various circles.

B — Shaft end is taken as front face, so all circles will show true. Draw shaft center line at 45 deg. Each square crossed diagonally represents 2 inches. Mark and number circle centers as shown. On each center draw the corresponding circles. For example, on center 18 draw a 2-in. radius circle for the shaft and a 3-in. radius for the hub. Drawing 45-degree edge lines and erasing hidden parts gives the pictorial effect shown. Position of the top crank is located by the 15-in. rise and 4-in. offset

deg oblique. All look like the object. On the whole, sketches *B* to *F*, inclusive, are clearest as well as easiest to draw.

The special offset wrench shown in Fig. 7 *A* is a good practice exercise, because it brings up the problem of rounded shapes. These are hard to handle directly. The trick is to turn them into square corners in the orthographic views and then produce the corresponding oblique sketch, after which the corners can be rounded again.

Fig. 7 *B* shows the square-corner equivalent of *A*, and *C* shows *B* as an oblique sketch. On *C* the rounded corners are worked in lightly free hand as shown. Then the curves are drawn heavy and the square corners erased as shown at 7 *D*.

The squaring of round parts and later rounding of square parts is one important trick in making oblique sketches. Another is selection of the best face for the front view. In general the selection is made with a view to saving labor. Pick the most difficult face for the front side—generally one of irregular shape or containing circles.

For example, the bushing shown in Fig. 8 *A* can be shown as at *B* or as at *C*. The former requires drawing the circles as ellipses inscribed in shapes representing squares. In *C*, on the other hand, the circles are drawn with compasses as true circles. In both *B* and *C* note that the bushing may be viewed as inscribed in a box. This idea will help in drawing many types of round objects. They can all be fitted in boxes, which can then be sketched in 45-deg oblique.

Some sketches that appear difficult are really quite simple—9 *B* for example. Here the difficult face of the pipe clamp shown in 9 *A* is selected as the front face of the oblique, and is copied exactly. Depth is 2 in., so 45-deg lines equal to one square diagonal are drawn from various points of this face view. The circles on the back side are drawn from a center one square up right diagonally from the center of the front circles.

How to Sketch Fig. 10

All of the foregoing has been very simple. Fig. 10 is introduced as an example of a more difficult sketch—one the reader may wish to copy as a good exercise. The object shown at *A* is a bell-crank lever made up of two crank arms on a shaft. Note that the drawing consists mainly of a series of circles drawn about points on the center line of the shaft. In *B* the center line of the shaft is a 45 degree line on which are respotted the various center points numbered on *A*. For example, center point 18 on *A* is 18 inches from the near end of the shaft. Two circles are to be drawn around point 18 on *B*, one of 2-in. radius representing the shaft, and one of 3-in. radius representing the hub. The same two circles are drawn from center 2. Except for the arms, the only other lines are 45 degree lines tangent to the circles. The chief trick is to erase all lines that would be hidden. Note that the upper arm is located by its 15-in. rise and 4-in. offset.

Editorial Postscript

THE MAIN PURPOSE of this article is to get more power engineers into the habit of expressing themselves in free hand perspective sketches. They're fun to make and serve many practical purposes. In the course of a year I travel thousands of miles and visit scores of plants. Everywhere I see the effective use of home-made pictures—the fine drawing on the drafting board, the neat sketch on the pad on the engineers desk, the diagram hastily chalked on a piece of board or the back of a water tank or a steel column. All tell a story better than words, convey ideas, create mutual understanding, get things done. *PWS*

MODEL MAINTENANCE SCHEDULE

Insures Trouble-Free Operation

"Follow a planned maintenance program" is the Golden Rule of all power engineers who believe an ounce of prevention is worth a pound of cure, and that you've got to think ahead of trouble to keep ahead of it. Here's the schedule laid out by H A F Campbell for the Mechanical Dept of Geo E Keith Co (Walk-Over Shoes), Campbello, Brockton, Mass. It won't fit your plant exactly but it may give you an idea or two worth trying

Every Day

Inspect all low-pressure, high-pressure, and return piping in buildings and tunnels. Any leak or trouble must be attended to at once

Inspect and adjust boiler- and pump-room setups, including oil-burning system

Once a Month

Repair or adjust all leaky ball cocks, faucets, bubblers, water coolers and water valves in all toilet rooms

Check cold-water pump in Room No. 11

Go over all sprinkler systems with their valves and controls, wet and dry, and see that all valves are set correctly. American District Telegraph Co inspects entire sprinkler system the first of each month

Inspect street mains, hydrants, fire pump, fire pails, stair doors and the 100,000-gal reservoir

Service and oil all elevator machinery. Otis man also inspects at first of month and reports

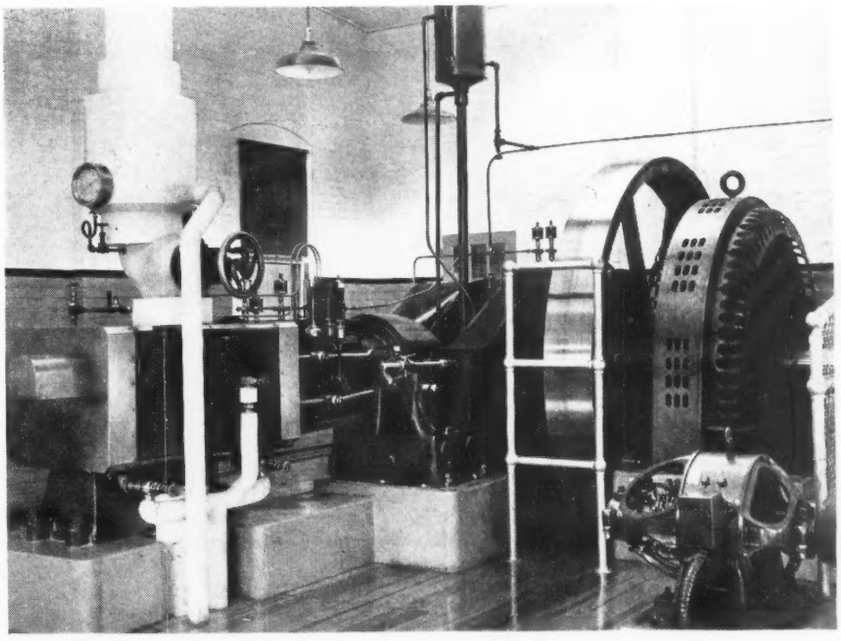
Twice a Year

Between runs, check all line shafting; oil and grease bearings; inspect and dress all belting; check and oil all mullers and dryers

Oil, test and clean all sump pumps

Check and oil boiler-room conveyor

Inspect and grease, or oil, all blowers and their motors



Maintenance program in action—spotless engine room of Geo E Keith Co's Campbello plant gives eye-witness testimony of schedule's effectiveness

Clean base of boiler-room stack and boiler-outlet breechings

Check and change oil in air-compressor and pumps

Check cutting-room conveyor and Lamson dryers

Clean and service all motors and controls

Check all main fuses and feeder connections in all buildings

Clean back of switchboards

Inspect main transformers

Go over time clocks, batteries and telephone service

Have carpenters inspect all windows, glazing, doors, locks, stairs and floors

Once a Year

At beginning of heating season, check (1) high-pressure traps, (2) vacuum system on steam heating, (3) flow of steam at all radiators, coil banks and traps, (4) thermostatic heating system in Room No. 11 and have service company go over it, (5) high-pressure reducing valves

Inspect and clean out all hot-water tanks

Clean and paint tanks in No. 11 water cooler

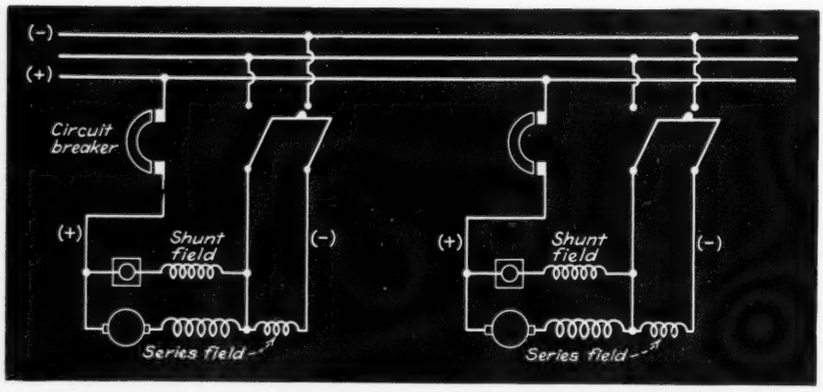
Paint and touch up all mullers, dryers

READERS' PROBLEMS

Questions from Our Readers

How Did It Happen?

Question 1



TWO COMPOUND-WOUND EXCITERS *were connected for normal operation in parallel. There was the usual neutral connection and the field and neutral leads of each machine went to the same double-pole switch. The remaining armature lead connected to a single-pole switch, as shown in the sketch. With the leads arranged in this manner, operating practice required that the double-pole switch always be closed first when paralleling. These machines operated satisfactorily both before and after the following incident.*

One evening the operator in paralleling the exciters caused a reversal of polarity in both of them, yet they remained in parallel and carried the evening load with no inconvenience except that the ammeters and voltmeters did not register. It was necessary to flash the fields in the reverse direction to bring the machines back to normal. Can events that caused this condition which, on the surface, looks inexplainable?

—EWI

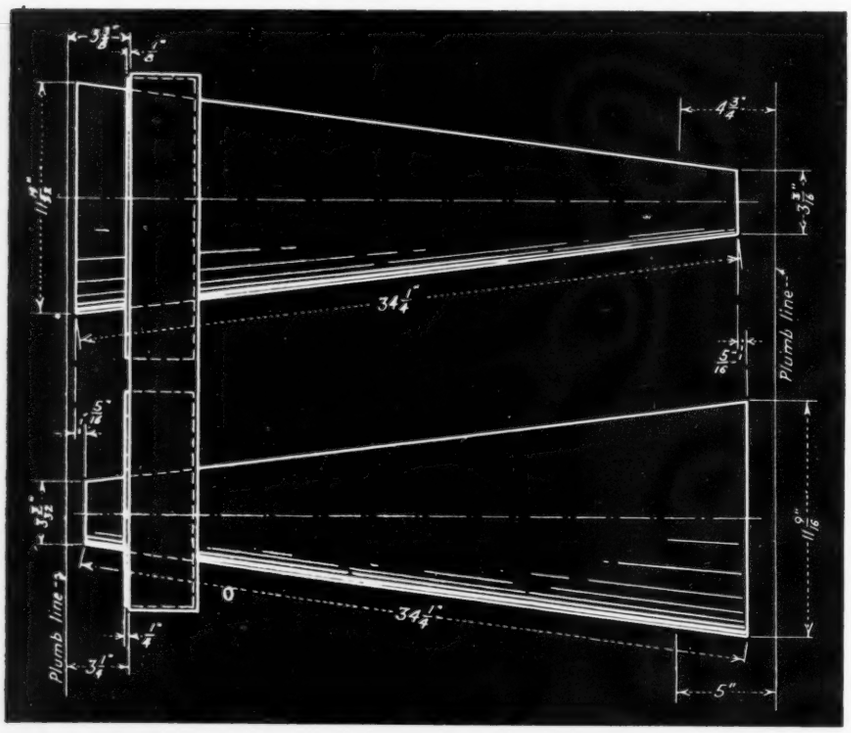
Finding Engine Speed

Question 2

SOME OF OUR YOUNG ENGINEERS SAY *that examiners are asking the following question: "Assume a shaft-governed steam engine without a nameplate on engine or generator. The engine is idle and must not be started to permit use of a speed indicator. How can the engine speed be found?" I wonder if* POWER *readers have any ideas on the solution of this problem which looks like a trick question, with only one simple answer.*

—WHF

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.



Belt Alignment

Answers to Aug Question 1

The Question

WE ARE HAVING TROUBLE *with the variable-speed arrangement on our twin engines. The lower cone shaft is level and parallel with the flywheel shaft; the upper cone shaft is parallel with the lower shaft and the guides are plumb, or at right angles to the cone shafts. When the belts are at the left, as shown in the sketch, and about 2½ in. from the end of the cones, the wrapping belt is ⅛ in. off the upper cone belt and about ¼ in. off the lower cone belt. The upper cone belt is free between the guides but the lower cone belt rubs slightly. The wrapping belt is ½ in. away from the left guide, but only ⅛ in. away from the right guide. If the belts are moved further left to ¾ in. from the end of the cones, everything remains the same except that the wrapping belt is also off the upper cone ¼ in.*

When the belts are at the middle of the cones the wrapping belt is off the upper cone belt 1/8 in. and the lower cone belt 1/4 in., but the wrapping belt is in the middle of the guides. The upper cone belt rubs slightly on the right guide and the lower cone belt rubs slightly on the left guide. If the belts are moved to the right until the belts are about 3 1/2 in. from the end of the cones, the wrapping belt and the upper cone belt rub on the right guide and the lower cone belt rubs on the left guide. The sketch shows that the cones differ slightly in diameter but have the same length. Can any POWER *reader explain this condition and suggest a remedy?*—GH

Discusses the Problem From Soup to Nuts

APPARENTLY GH IS EXPECTING TOO MUCH of this variable-speed drive. As long as the belt rubbing against the guides is not serious I would not worry about it. This drive at best cannot be expected to be just 100% perfect in its operation. This is seldom found in a flat belt running on crowned pulleys, because we are not dealing with a perfect power-transmission medium.

Belts may not be perfectly straight and equal in thickness, pulleys and shafting may not be in correct alignment, dirt deposits may collect on the surfaces of the belt and pulleys; these and other causes may produce irregularities in belt operation. From this it should not be understood that flat belts do not operate satisfactorily, for just the reverse is true. In fact, no piece of power-transmission equipment will take more abuse than a flat belt and still give service, or can be as easily repaired or replaced at as low a cost.

In his diagram, GH indicates that the cones are not absolutely alike, and this in itself might be enough to cause the irregularities in operation of which he complains. The cone-pulley shafts are said to be parallel and level. Unless care is taken in making this check the pulleys may not be in proper alignment. Again, the cone shafts may be level and parallel when the engine and load belts are off but not with these belts in place driving the load.

Care should be taken to check both bearing guides to make sure that they are plumb. If the foundation for the bearing guides is not true and level the guides for one set of bearings may be plumb, and the guides for the other bearings out of plumb. In other words, aligning the cone pulleys must be handled carefully to make sure that they are in proper alignment when they are running and driving full load.

By the nature of the drive, the belts tend to creep and slip more than on a standard flat-belt drive. This increases the wear on the cone surfaces and also on the transformer belts running on the cones. As a result, the surface of the cone pulleys may be worn out of true. This would cause a difference in the belt performance at different locations along the cones. The tapered leather strips on the inside of the transformer belts may have worn more at one end than at the other, which would have the same effect as the cone shaft not being in proper alignment.

The transmission belt, being short and operating on fixed centers, is working under unfavorable conditions. As a result, it is more sensitive to slight imperfections than would be the case with a longer belt or one in which tension was maintained automatically. Unless tension is carefully maintained in the belt a small amount of stretch may cause slipping, especially if the drive is heavily loaded.

The belt should be maintained in good operating condition, for if it is allowed to dry out, the surface in contact with the transformer belts will become hard. Under such conditions the coefficient of friction of the belt may be reduced to where it will slip even when operating with high tension.

These belts are generally quite wide, particularly on the larger capacity drives. In some cases it has been found that the leather was not the same quality on both sides of the belt, consequently the belt stretched more on one side than on the other. This gave the same effect as if the ends of the belt had not been properly aligned before they were cemented together.

I would therefore advise GH to check the belt to make sure that it is the same length on both sides and that it is straight. Also check the transformer belts to see if they are approximately level when they are resting on the cones.

GH's problem is one to which there appears to be no direct answer, because the effects mentioned may result from any one of a number of things or a little bit of several. The latter is particularly true if the effects are cumulative in the same direction. Again I wish to emphasize that the reader should not get the impression that this type of variable-speed transmission is a troublesome one. It was one of the first types of variable-speed transmission developed. The fact that it is still with us, when many others have come and gone, speaks well of its service record.

Boston, Mass. B R STEWART

Blames Wear and Tear

GH'S TROUBLE MAY BE CAUSED by a combination of circumstances. Assuming that the drive operated satisfactorily when new, the present trouble may be caused by gradual bearing wear, loss of cross-section shape of cone belts, or glazing of belt surfaces.

Under some conditions, short wide belts do not work properly on pulley crowns and require perfect pulley alignment. In this particular case, the crowned surface of the cone belts may have disappeared because of slippage wear or constant compression of the leather. Slippage between one cone and cone belt may have worn the cone-belt segments more on one end than on the other, which would throw its belt surface out of parallel with the other cone belt.

As the cone bearings are usually adjustable for tightening the drive belt, the cones may now be slightly out of parallel. The fact that the cones are the same length but have different diameters means that the tapers are not identical. Using cone belts of the same taper on dissimilar tapered cones will cause trouble, but if this is the case it should have appeared at the start.

In a drive of this kind it is logical to believe that friction will be greater between the drive and cone belts, than between the cone belts and cones. It still remains a fact that any wear of the cone-belt surfaces next to the cone will produce an effect on the outside surface of the cone belt.

Chicago, Ill. W RELLEF

Draft Troubles

Answers to Aug Question 2

The Question

OUR BOILER PLANT *consists of three hrt boilers set in battery. Each boiler has a 48x16-in. smoke uptake discharging into a 48-in. diameter stack connection which passes over the boiler fronts. We are frequently troubled with poor draft for one or another of the units, especially if some other boiler of the battery is operated with forced draft. How can the drafts be equalized?*—LMR

Check For Air Leaks

I WOULD SUGGEST THAT LMR CHECK his stack, breeching, boiler setting, and furnace doors for air leaks. Check stack and breeching to see that there are no obstructions in them. Check the dampers to see that they are tight on the

rods and work properly and do not retard flue-gas flow when they are open.

Test the flue gas for CO_2 in the last boiler pass and also where the breeching enters the stack, to find the amount of air leakage between the boilers and the stack.

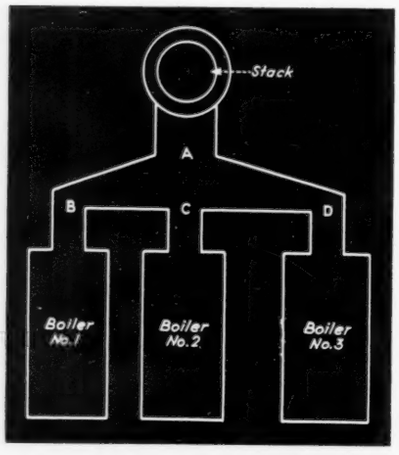
The amount of draft required by each boiler will depend upon the load on the boiler, the kind and size of coal, thickness of fuel bed, and whether natural or forced draft is used. With natural draft, 0.1 or 0.4 in. is usually sufficient. With forced draft, approximately 0.03 in. over the fire should be used, with enough pressure in the windbox to burn the required amount of coal.

My rule for setting dampers is to keep the draft as low as possible, to carry the load, to prevent smoking, and to keep the grates from overheating.

Lombard, Ill. H D Brown

Pressure vs Draft

The sketch probably illustrates the conditions existing at LMR's plant. The amount of draft at the chimney entrance is common to all boilers under natural-draft conditions; and the pressure at the outlet of each boiler must be somewhat higher, otherwise the gas will not flow to the stack. If these pressures are equal (assuming the breeching and damper resistance to be equal) the flow of gas from all boilers will be equal.



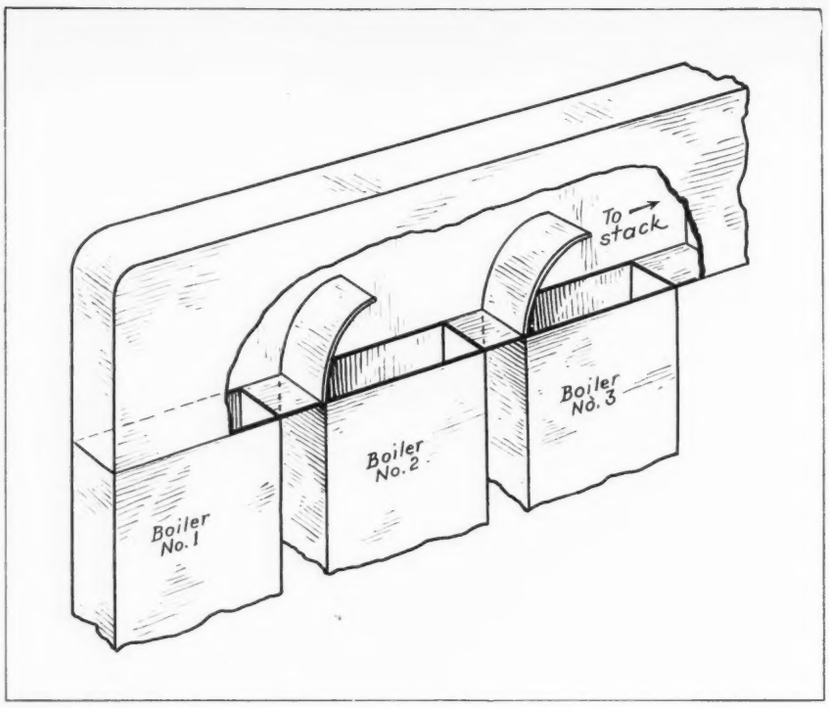
When one or more circuits come together in this way they must all have the same pressure at the junction (chimney). If any gas is to flow from the boiler outlets to the junction, the pressure at the outlets must be higher (that is, the draft must be lower) and the amount of flow will be proportional to this difference, divided by the resistance of the flue.

Assume that we start a forced-draft fan on Boiler 2. The pressure at the stack will be raised, and will tend to equal that existing at the outlets of the other boilers. These boilers will try to compensate for this by passing less gas, thus cutting down the pressure loss through the boilers themselves. This means that they will drop part of their loads.

By careful hand regulation, we may control the fan-operated boiler, so that it does not take all the load off the weaker ones. If, however, we run the fans on the other boilers, we shall have a much easier regulating problem, as we shall have the same range of control on all boilers.

With adequate draft-control equipment, proper regulation of a number of boilers can be assured, but it is doubtful whether the manufacturers of any of this equipment would advise the operation of natural-draft and forced-draft boilers on the same stack if it could possibly be avoided. LMR should operate all boilers either on natural or forced draft. If his boilers are not equipped with good damper regulators, these should be supplied. A complete control system might be a good investment.

Bloomfield, N. J. J O G Gibbons



Jet-Pump Action

LMR's trouble seems to be in the boiler that is being operated with forced draft while the other two are operating with natural draft. This creates an unbalanced draft condition in these two boilers. To obtain the best gas flow from uptake stack duct, all connections should be made with easy bends where the direction of travel is changed.

To get equalization of draft in these boilers, each boiler uptake should be provided with a baffle as shown.

With this arrangement the gas discharged from a boiler under forced draft exerts a jet-pump action rather than an obstruction to the discharge gas from the other boilers.

Philadelphia, Pa. W T Mullen

Install Baffles

In connection with question No. 2 by LMR in August Power, it is a little difficult to prescribe a cure for his problem without knowing all the details of the set-up.

A smoke stack, for instance, can give only a certain amount of draft, depending on size, height and other factors. A condition which is always true where more than one boiler is connected to a stack is that the boiler nearest the stack will get the strongest draft. We notice in LMR's case that the stack connections are all the same size. Other conditions being the same, the connection nearest the stack will have the strongest draft. These may be equalized with dampers which can be controlled from the floor; or if possible the two draft connections nearest the stack may be provided with a baffle to cause the gas being discharged from the boilers

using forced draft, to exert more or less of a jet-pump action, rather than acting just as an obstruction to the discharge of the gas from the other boilers.

Lakewood, Ohio J P SIMONS

Try Induced-Draft Fan

WITH THE BREECHING AND STACK ARRANGEMENT LMR mentions, there is always the problem of having one boiler robbing the others, especially where there is one forced-draft boiler and no common induced-draft fan on the battery of boilers.

LMR could erect a separate stack for each boiler. If this is not feasible an induced-draft fan could be installed which would be common to all the boilers. Another remedy would be to install a separate stack breeching for each boiler if it is found that the loss is due to the common stack breeching.

Bismarck, N. D. L BRADLEY

Add Another Stack Connection

IN LMR'S INSTALLATION each boiler uptake has an area of 5.33 sq ft or a total of 16 sq ft uptake area, feeding into a stack connection passage of 12.5 sq ft in area. The area of the stack connection appears to be too small, resulting in an excessive pressure drop or draft loss.

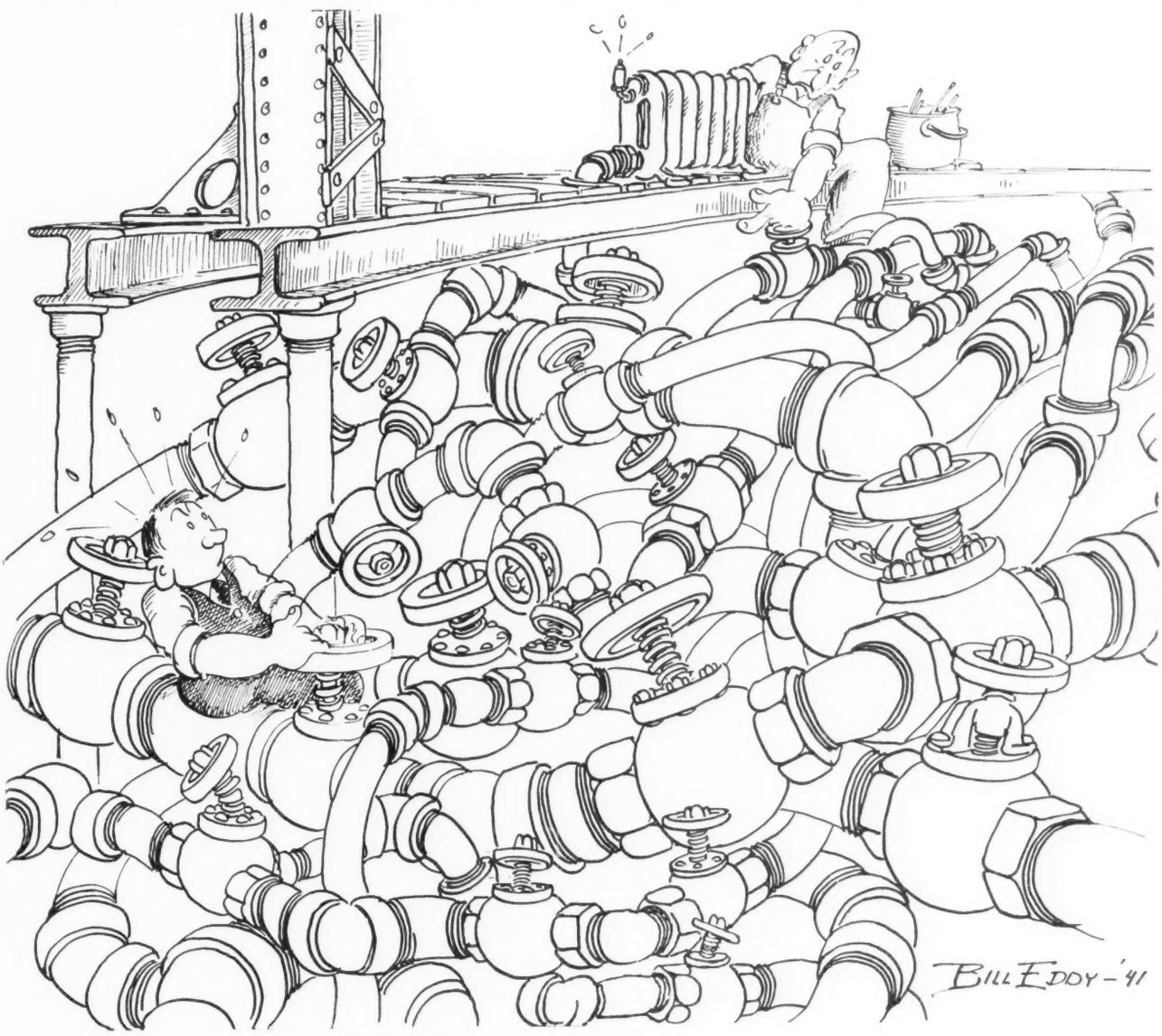
When forced draft is used under one of the boilers its rating is increased, with a corresponding increase in gas flow. This increased gas flow decreases the natural draft acting on the remaining boilers. Loss of draft causes a reduction in load or a transfer of load from the natural-draft boilers to the one using forced draft. Forced draft should be used on the boiler having the weak draft when under natural-draft firing.

Staten Island, N. Y. R ATLAS

Use Streamlined Passages

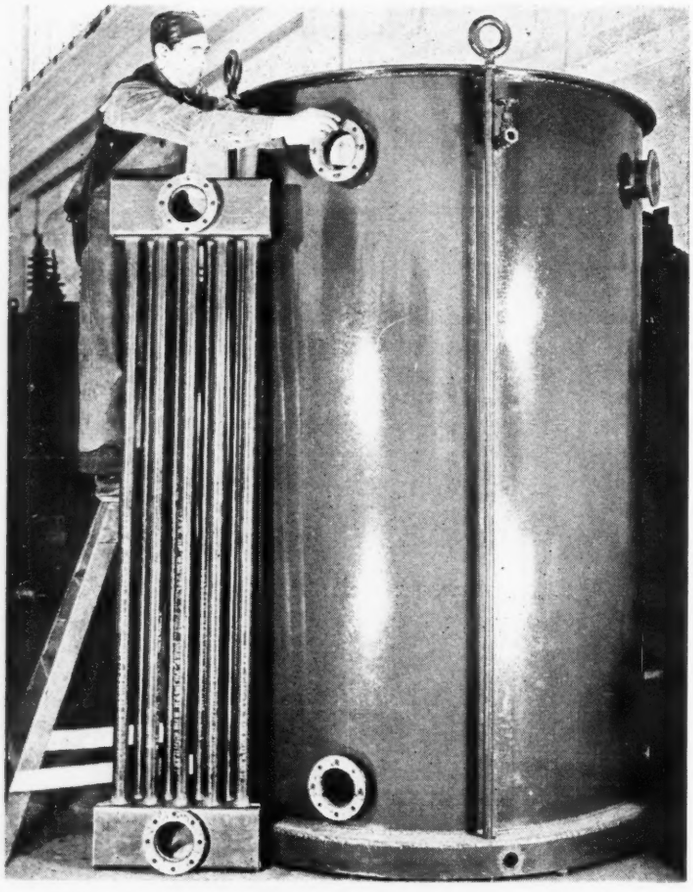
TO OBTAIN THE BEST RESULTS from smoke connections of a given size, all the junctions of the uptakes with the main stack connection, as well as the main stack-connection junction at the chimney, should be made with easy bends so that flow of the flue gas may be smooth and continuous. For obtaining equalization of draft, each boiler uptake except the one farthest from the stack should be provided with a baffle. When the gas is discharged into the main connection, its flow will be toward the stack before coming in contact with flue gas discharged from the other boilers. With this arrangement the gas discharged from a boiler with stronger draft exerts a jet-pump action rather than an obstruction to the discharge of the furnace gas from the other boilers.

Fairview, N. J. M GOZDENOVICH



"Now Henshaw, let's look at this logically"

PRACTICAL AIDS TO OPERATION



Water-Cooled Transformers Changed to Self-Cooling

NOW THAT POWER EQUIPMENT is becoming difficult to get, the methods of the city of Seattle, Wash., lighting department will be of interest. Conversion of power transformers from water-cooled to self-cooled types is now a current practice in this department's shops. This is done by fitting tubular radiators to the transformer tanks to provide cooling surface for the insulating oil.

Stock steel tubes cut to the proper length are welded between headers, as in the photo. These headers are made of No. 10-gage steel plate fabricated, welded and flanged for connecting to the transformer tank. Similar flanges and other connections and accessories are welded to the tank. All welded joints are treated on the inside of the tank with a special varnish highly resistant to oil, as a precaution against leaks. Gaskets used in the joints between the radiator and transformer flanges are also treated with this varnish.

Port Blakely, Wash.

MANDUS F BRIDSTON

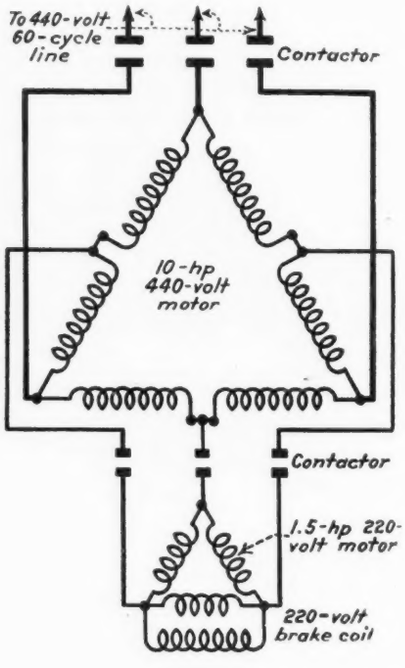
Shellac and Tape Protect Rubber Hose

SYNTHETIC-RUBBER HOSE is resistant to oil and should be used where it is present. However, natural-rubber hose must sometimes be used under oily conditions. Under these circumstances I have found that a good coat of shellac on the outside of the hose will give substantial protection against the oil and increase the life of the rubber. Another method is to wrap the hose with a single layer of cotton tape and then give this a brush coat of sodium silicate. This develops a firm but resilient coating that will resist damage by oil, abrasion, and heat.

Essex, England W E WARNER

Operates Small Motor From Large One

WE RECENTLY INSTALLED A SHEAR that had a 10-hp, 440-volt main motor and a 1.5-hp, 220-volt motor equipped with a solenoid-operated brake for adjusting the stroke of the ram. As only 440-volt power was available we had to figure out some way of getting 220-volt power for the smaller motor. Fortunately, the

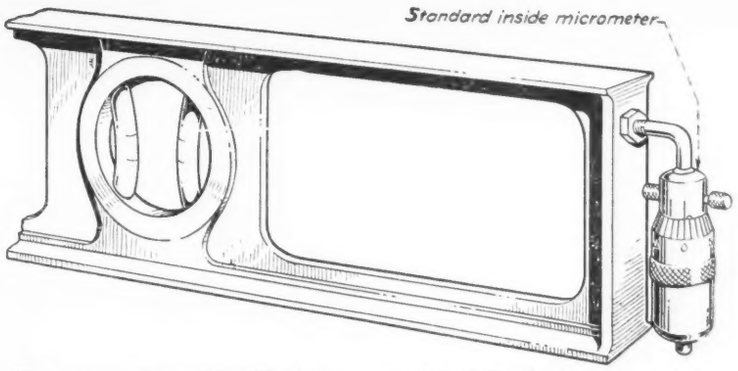


terminals were brought out of the larger motor so that they could be arranged for 440- or 220-volt connections.

We therefore connected the smaller motor to the 220-volt taps, as in the figure. Since this motor operates intermittently, this connection could be used without overheating the larger motor. This is a phantom delta connection and the heating effect caused in the larger motor by the smaller one is equal to the current of the latter divided by 0.58, which should be added to the current taken by the main motor when calculating its possible load.

Nashville, Tenn. E L HEMENWAY

Micrometer Simplifies Leveling Job



OUR STORAGE BUILDING, a one-story steel-frame structure, was built on very poor ground; as a result the columns settled unevenly. To maintain the roof girders level it is necessary to lift them off the columns and block them level.

To simplify this work I bored and tapped the end of the level for a threaded rod of a size that would go into an inside micrometer. The threaded rod for the hole was bent to a right angle, screwed into the hole in the level and fixed in place with a locknut. The micrometer was placed on this fitting as in the figure.

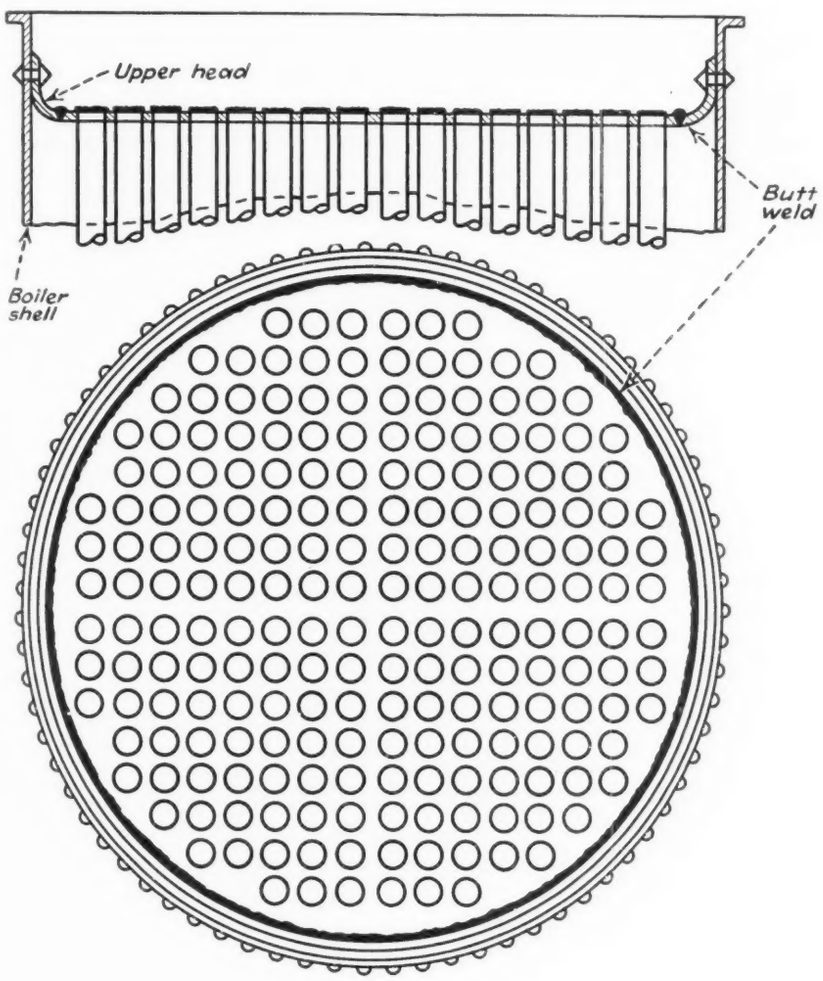
To use the level I first set the mike at zero, put the level on a straight surface and adjust the mike on the fitting until its free end just touches the surface. To measure "out-of-level" of the steel beams, I place the level against their under side and adjust the mike until level is obtained. If the mike shows 0.1 in. out of level, then, since the level is 2 ft. long, the beam is $0.1 \div 2 = 0.05$ in. out of level per foot.

To simplify the job of leveling I have numbered all the beams. Now I go over each and check the amount it is out of level and make a record. From this record, blocking is made up to the proper thickness. Then when everything is ready, we jack up the low ends of the beams and install the blocking. The job is completed in a small fraction of the time originally required.

Englewood, N. J. R BOETTINGER

Upper Head Welded in Vertical Tubular Boiler

REPLACEMENT OF THE UPPER HEAD in a vertical tubular boiler is a major repair no matter how it is done. Welding, however, provides a short cut that may save considerable time and money. It should be pointed out that while the repair described is considered entirely safe under nearly all circumstances, it should be sanctioned by any existing boiler laws in the particular state or municipality, and should be approved by an authorized boiler inspector.



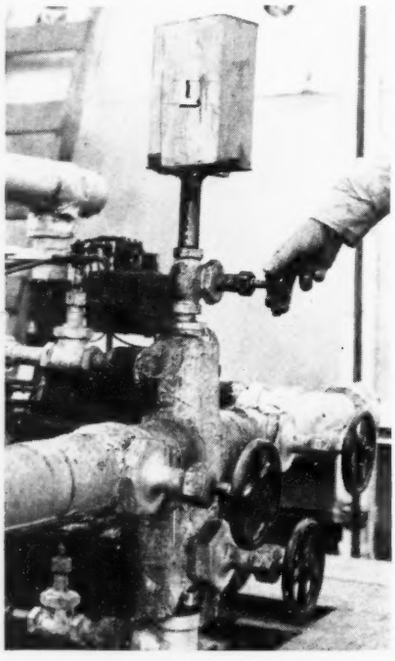
The old head is cut between the flange and the tubes. The cut should be made a 45-deg bevel, and can be easily done with a cutting torch. A plain disk, drilled according to the tube layout, forms the replacement head, without any flanging expense. Select a disk of open-hearth firebox steel having a tensile strength at least equal to that of the plate removed and having the same thickness. Bevel its edges around the circumference at a 45-deg angle. Drill the tube-holes $\frac{1}{16}$ in. larger in diameter than the outside diameter of the tubes. Round the tube-hole edges or chamfer to remove any sharp corners. After tack welding in position, the tubes should be installed, rolled and beaded, after which welding is completed. This repair may also be made on a vertical boiler with the head put in the reverse to the one shown.

Make a hydrostatic test as required by local authorities to check the weld tightness. If there are no local requirements, it is suggested that the test be at a pressure of from 1.25 to 1.5 times working pressure with a water temperature of 70 to 120 deg. F.

As an operating precaution after such a repair, guard against the possibility of icicles. When a single butt-weld is made from the outside with no backing strip, fusion at the root of the weld

may cause some molten metal to drip into the boiler. Globules of solidified metal have no place in a boiler where they might be carried out and jam a valve. To prevent this, flush the boiler thoroughly and examine the internal surfaces of the waterleg at the mud-ring before placing the boiler in service.

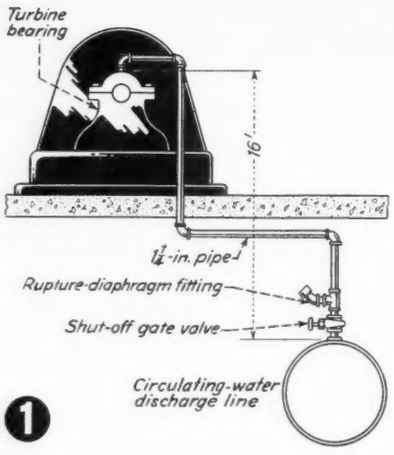
Cleveland, Ohio A G WIGGINS

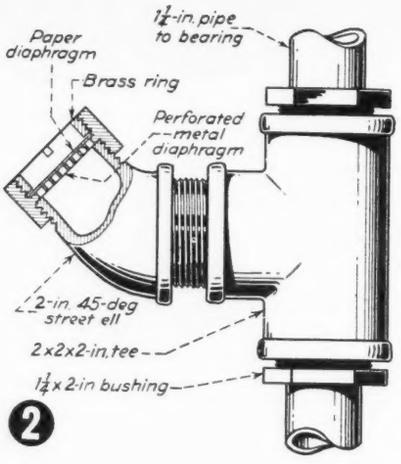


Lubricating-Oil Heater

WHEN OPERATING A BATTERY of boilers outdoors in a cold climate we experienced difficulty in keeping the lubricating oil in a fluid state for use in the lubricators. At a tee in the feedpump steam line the operator installed a short vertical nipple with a valve. A second nipple was quartered for part of its length and the quarters bent outward to form a fairly flat support on which the oil container was set, as at *L* in the photo. To keep the oil warm the valve is cracked slightly to permit a small amount of steam to blow up over the container. When necessary to heat up quickly a new container, the valve can be opened more than is normally done.

Pomona, Calif. GILBERT M WILSON





Vacuum Eliminates Bearing-Oil Vapors

ON ONE OF OUR TURBO-GENERATORS a bearing persisted in giving out oil vapors despite all attempts to stop it. This vapor was sucked into the exciter and deposited on the windings along with atmospheric dust. Not being able to prevent the oil vapors we decided to dispose of them by connecting the top of the bearing into the condenser circulating-water discharge, as in Fig. 1. This line we knew operated continuously under a vacuum of from 8 to 9 in. Of course, there was the hazard that sometime a positive pressure might develop in the line and flood the bearing.

To overcome this hazard we first considered using an ordinary swing-check valve. As the valve might not operate dependably, we therefore made the device, Fig. 2, which consists of a plate, bored full of ⅛-in. holes, in a brass fitting. A paper diaphragm is placed over the holes and held in place by a brass ring threaded into the fitting. Now, if positive pressure develops in the discharge line the paper diaphragm fails and lets the water flow out, before it reaches the bearing.

Numerous tests led to the selection of an onion-skin typewriter paper. This paper, 0.002 in. thick, ruptures at about 2.25 lb per sq in. in about 1 sec. A static pressure of 7 lb per sq in. is necessary before water will reach the bearing.

We found that it was necessary to place the diaphragm at an angle of 45 deg to eliminate two difficulties. When in a vertical position, condensed vapors collected on the lower edge of the diaphragm and weakened the paper so that it failed. When placed horizontally, the air pocket below the diaphragm prevented water reaching the paper when there was a change from vacuum to positive pressure.

Tecumseh, Kan. H M NAYLOR

Phosphoric Acid Controls Alkalinity

USE OF VARIOUS SODIUM-PHOSPHATE COMPOUNDS in boiler-water conditioning is quite common in industrial steam-generating plants. Properly applied and controlled these agents are among the most effective treating chemicals used for primary scale-inhibiting reactions within the water space of the boiler. Their one disadvantage, however, especially in plants requiring considerable quantities of make-up and having raw-water supplies containing sodium alkalinity, is their tendency to further increase alkaline concentrations in the treated water, necessitating increased blowdown.

There are a number of methods by which this sodium alkalinity can be controlled. Use of monosodium phosphate or bisodium phosphate, instead of trisodium phosphate, will permit the addition of more of the phosphate radical for a given sodium-alkalinity concentration increase. The use of phosphoric acid is even more effective because it does not increase alkalinity but reduces it by reacting with the sodium carbonate and sodium hydroxide already present in the boiler water. Its use, however, must be carefully controlled by frequent boiler-water analyses to prevent a reduction in alkalinity below the point where boiler-metal corrosion will occur. Piping through which the acid is pumped should be made of stainless steel or other metal unaffected by acid corrosion.

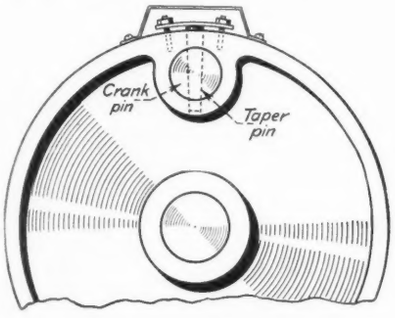
Maintaining suggested ASME sodium-sulphate-alkalinity ratios quite frequently requires the addition of sodium sulphate to the treating solution. Here the substitution of acid sodium-sulphate or salt cake for the neutral sodium-sulphate will also help in controlling alkalinity, since the free acid radical in this material combines with alkalinity to

form sodium sulphate. Like phosphoric acid, however, its use must be carefully controlled and special piping used.

Roanoke, Va. S H COLEMAN

Curing Cranky Crankpin

WE HAD TROUBLE keeping a crankpin tight, so developed the idea shown in the figure. First, we installed the crankpin with a shrink fit. We then drilled and reamed the crank disk and pin for a No. 12 standard taper pin, which was driven home. To make sure that the pin would not work loose we clamped it in



place with a short steel bar held by two studs tapped into the crank disk.

Jackson, Mich. P M VAN WINGEN

From Junk Pile to Pipe-Threading Machine

IN THESE DAYS OF PRIORITIES and other restrictions that make equipment difficult to get, my pipe-cutting and threading machine may interest POWER readers. The main parts comprise two automobile transmissions, two universal joints, a gear and pinion, and one V-belt and sheaves all procured at a cost of $5.25. A ½-hp motor drives the unit. Fig. 2 shows the pipe-cutting and threading end of the machine with the die in place for cutting a thread on the end of a pipe. The pipe cutter is in place in Fig. 1. The two automobile transmissions, through which the motor drives the operating head, provide the proper gearing.

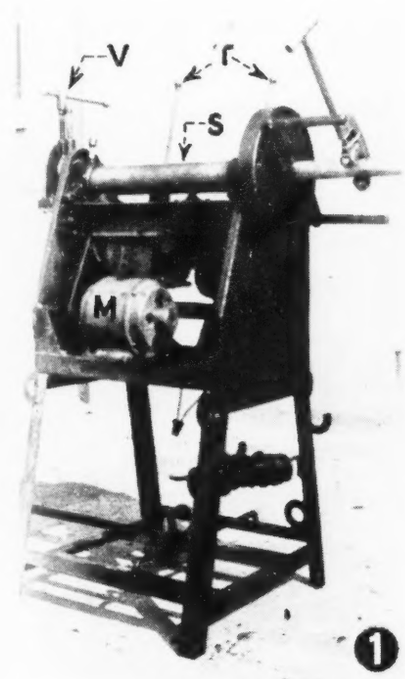
A hollow spindle *S*, 2½ in. inside diameter is supported in a bearing at each end of the machine. The right-hand end of the spindle mounts the driving arms for the die stock and pipe cutter. On the hub of these arms is the gear that meshes into a pinion on the output shaft of one of the two transmissions, the shift levers of which can be seen at *T*. These transmissions are coupled together and are V-belt driven by the motor, *M*.

As shown in the photos, one end of the machine mounts a pipe vise, *V*, mounted on a piece of angle iron, which is supported on gibbs so that the vise can be centered for different pipe sizes. The motor connects to an attachment plug and snap switch.

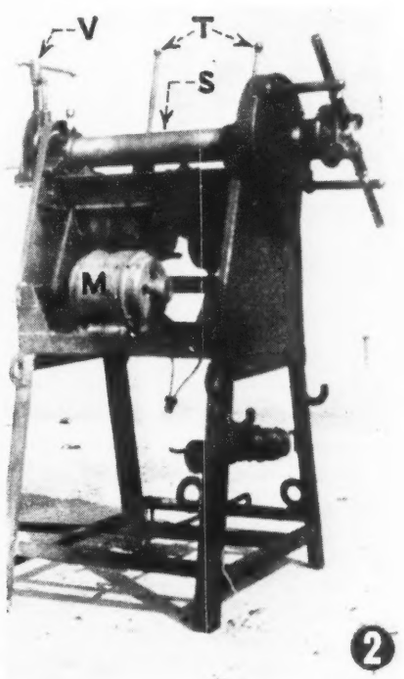
The equipment described is for pipe sizes up to and including 2 in. in diameter. For larger pipes I have a 7-ft telescopic shaft with a universal joint on each end. Connected to one universal joint is a cross head with two sockets to fit onto the pin in the crosshead of the pipe machine. On the other universal joint a fitting connects to the ratchet shaft of a large ratchet pipe die.

The pipe is held in a bench vise, and the die put on its end and started just enough to hold it in place. Then the pipe-threading machine is connected by the telescopic shaft and its fittings, the transmissions set for the right speed and the motor switched on, after which the motor does all the work. When the thread is cut, the motor is stopped, one of the transmissions is put in reverse and motor started to back off the die.

Ironton, O. GEORGE T WHITE



1



2

Chain and Spring Make Simple Pipe Hanger

BEING IN NEED OF SOME INEXPENSIVE PIPE HANGERS, we made them of chain, as shown in the figure. To add flexibility we added a spring to each chain as shown and allowed sufficient chain slack within the spring for pipe movement due to temperature changes and other conditions. When all the slack is taken up the chain then acts as a limit stop for the spring.

New York, N. Y. T K HOLMEN
Consolidated Edison Co of New York

More About Heat Transfer

By PHIL SWAIN

LAST MONTH this page explained how heat is carried from one place to another by conduction, convection and radiation. This article will show how the laws of conduction are applied to practical problems, and add a word about figuring the surface of heat-transfer equipment.

First (reviewing last month) remember that the conduction of heat follows the same law as the conduction of electricity. *The heat conduction, in Btu per hour, is equal to the temperature difference between entering and leaving faces, multiplied by the conductance.*

The example shown in Fig. 1 will make this clearer. Silver is the best conductor of heat, with copper a close second. The "specific conductance" of copper is about 220. That means that if one face of a *one-foot cube* of copper is one degree F hotter than the opposite face, heat will flow from the hot face to the cold at the rate of 220 Btu per hour.

Let's apply this fact to the case shown, where a copper bar 1-in. square and 2 ft long is kept 300 F at one end and 200 F at the other. Find the heat flow. Both its smaller cross section and its greater length will give this bar a smaller conductance than the one foot cube. Since the area is divided by 144 and the length is multiplied by 2, the conductance of the bar will be $220 \div 144 \div 2 = 0.764$ Btu per hour per degree difference. The temperature difference is 300 F — 200 F = 100 deg. so the heat flow will be $100 \times 0.764 = 76.4$ Btu per hour.

Here is another example: At the other extreme from copper is an insulating material like 85% magnesia with a specific conductivity of about 0.04.

Consider a slab of this insulation 2 in. thick and one foot square with one side at 300 F and the other at 100 F. Since the piece is 1/6 ft thick, its conductivity will be six times that of the one-foot cube, or $6 \times 0.04 = 0.24$ Btu per hr per F. Temperature difference is 200 degrees, so heat flow will be $200 \times 0.24 = 48$ Btu per hour.

Flow Through Solids

Flow through solids by conduction is always the easy part in figuring heat transfer. Complications arise at the faces. Take the case of hot water in an iron pipe covered with 85% magnesia heat insulation (Fig. 2). Temperature falls from the water temperature to the air temperature in a series of slopes.

The temperature drop between any two points is proportional to the heat resistance between those points, just as voltage drop in each part of a d-c circuit is proportional to the electrical resistance of that part.

Note the film resistance (*a*) to the flow of heat from water to iron. This reduces as the water moves faster. You have the small resistance (*b*) to the flow of heat through the iron, the resistance (*c*) of the gap from the iron to the inner surface of

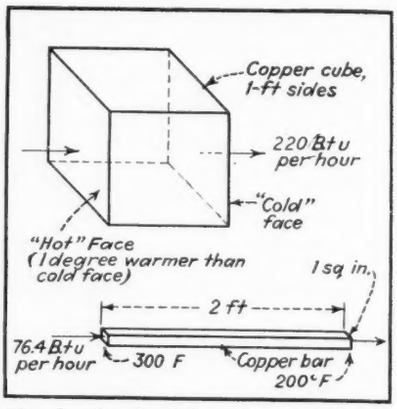


Fig. 1—Conductivity of copper bar is $220 \div 144 \div 2 = 0.764$. Heat transfer is $100 \times 0.764 = 76.4$ Btu per hr

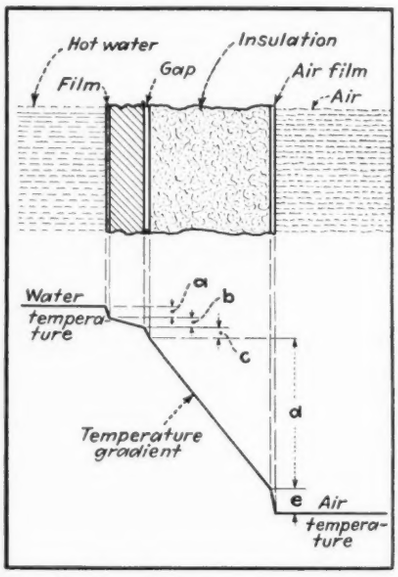


Fig. 2—So-called "temperature gradient" from hot-water temperature down to air temperature drops a little for small, drops far for large resistance

RANGE OF MISCELLANEOUS OVER-ALL COEFFICIENTS

(Heat transfer in Btu per hr per sq ft of surface per degree difference in temperature between two fluids. From a tabulation by A P Colburn in Perry's Chemical Engineer's Handbook, McGraw-Hill Book Co)

Type of heat exchanger	*Controlling Resistance*		*Typical fluid*	*Typical apparatus*
	U, free convection	*U, forced convection*		
Liquid to liquid	25–60	150–300	Water	Liquid-to-liquid heat exchanger
Liquid to liquid	5–10	20–50	Oil	
Liquid to gas (atm pressure)	1–3	2–10		Hot-water radiators
Liquid to boiling liquid	20–60	50–150	Water	Brine coolers
Liquid to boiling liquid	5–20	25–60	Oil	
Gas (atm pressure) to liquid	1–3	2–10		Air coolers, economizers
Gas (atm pressure) to gas	0.6–2	2–6		Steam superheaters
Gas (atm pressure) to boiling liquid	1–3	2–10		Steam boilers
Condensing vapor to liquid	50–200	150–800	Steam-water	Liquid heaters and condensers
Condensing vapor to liquid	10–30	20–60	Steam-oil	
Condensing vapor to liquid	10–80	60–150	Organic vapor-water	
Condensing vapor to liquid		15–300	Steam-gas mixture	
Condensing vapor to gas (atm pressure)	1–2	2–10		Steam pipes in air. Air heaters
Condensing vapor to boiling liquid	40–100			Scale-forming evaporators
Condensing vapor to boiling liquid	300–800		Steam-water	
Condensing vapor to boiling liquid	50–150		Steam-oil	

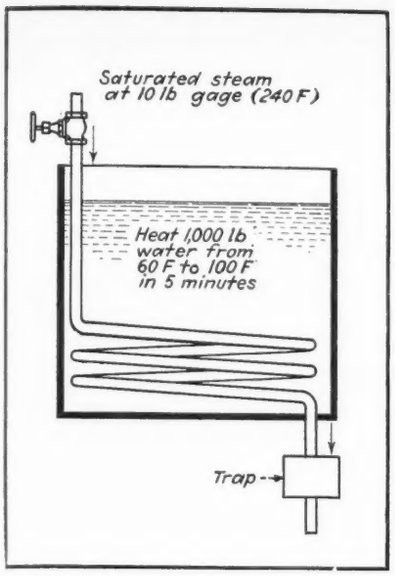


Fig. 3—How much tubing will be required to heat 1000 lb of water from 60 F to 100 F in 5 min? See text

the magnesia. Then you have the resistance (*d*) through the magnesia, which is the largest of all, and finally the film resistance (*e*) from the outside of the magnesia to the air.

To avoid a lot of complicated figuring it is customary to use tables showing how much heat will be lost per hour from a pipe of given size, containing steam at a given temperature and covered with a specified thickness of insulation of given type.

The operating engineer often runs headlong into a tough problem of heat transfer when he tries to figure how much coil surface will be needed to heat water or some other liquid in a tank. This would appear to be a simple problem, since reference books give the so-called "overall coefficients" of heat transfer. The trouble is that these coefficients vary all over the lot.

For example, the accompanying table gives values of "*U*" ranging from 50 to 200 for steam, in coils, heating water with natural circulation. If we use the 50 value, we will figure four times as much tubing as would be required for the 200 value. Suppose we take 100 for an "educated guess." This means that each square foot of tubing surface will transmit 100 Btu per hour for each degree of temperature difference between the steam and the water.

Suppose the assignment is to heat 1000 lb of water from 60 F to 100 F in 5 min. That is a total heat transfer of $1000 \times 40 = 40{,}000$ Btu in 5 min, or 480,000 Btu per hour.

Temperature of 10-lb steam is 240 F. Average water temperature is 80 F. Therefore average temperature difference between steam and water is 160. Each square foot of tubing will transmit $160 \times 100 = 16{,}000$ Btu per hour. The surface required will then be $480{,}000 \div 16{,}000 = 30$ sq ft. This is the arithmetic, but the computed answer may prove 100 per cent too high or 50 per cent too low, depending on the shape of the tank, shape and position of coils, etc.

Experience Counts

Where the engineer has experience with similar coils and tanks he should consider it more dependable than tables. Where he has no such experience he can extract a coefficient more or less by "guess" from the table, figure a coil on the safe side, try it out and then add more tubing if necessary. Not very scientific, but the best we can suggest without more experience!

✦ ✦ ✦

ARGUMENT CORNER

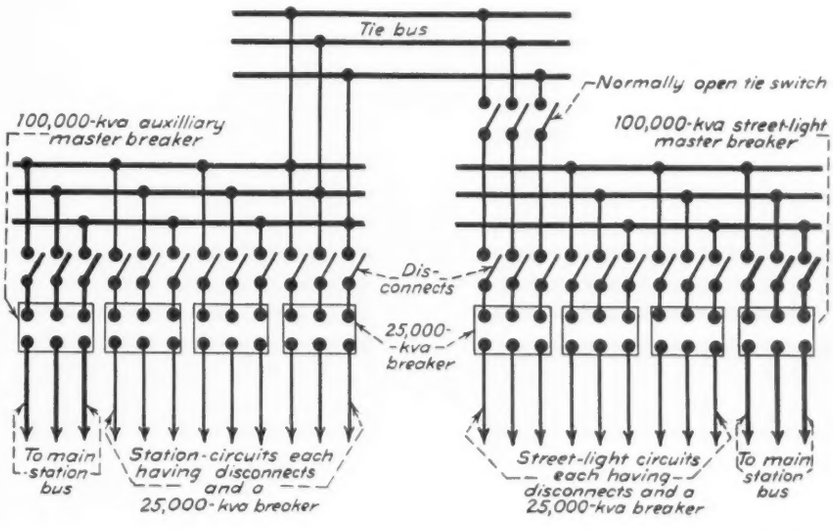
Oil Circuit Breakers Operated in Cascade

THE ARTICLE, "Circuit Breakers Used in Cascade," page 196, September 1941 POWER, recalls an installation at our generating station which was completed in 1936. With increased generating capacity the old installation of 25,000-kva switchgear was becoming overloaded from the point of view of short-circuit rupturing capacity. It was decided to install new 100,000 kva breakers with solenoid control on all generators and all outgoing circuits. We had a large number of 25,000-kva breakers on hand so we decided to utilize these in cascade with the larger breakers to give short-circuit protection.

We have three street-lighting circuits, which we connected to three 25,000-kva breakers which were overhauled and provided with induction relays for tripping. Next we connected a group of 2300-volt auxiliaries to refitted 25,000-kva breakers. Each of these two groups of low-capacity breakers was in turn connected to a master 100,000-kva breaker as in the figure. The relays were then set so that the master breaker in each case would open on a heavy overload corresponding to a short-circuit before the smaller breakers could open. On moderate overloads the master breakers remain closed and the smaller ones on the individual circuits open. By a proper selection and setting of the induction relays this is easily accomplished. Five years of operation have shown that this is entirely satisfactory.

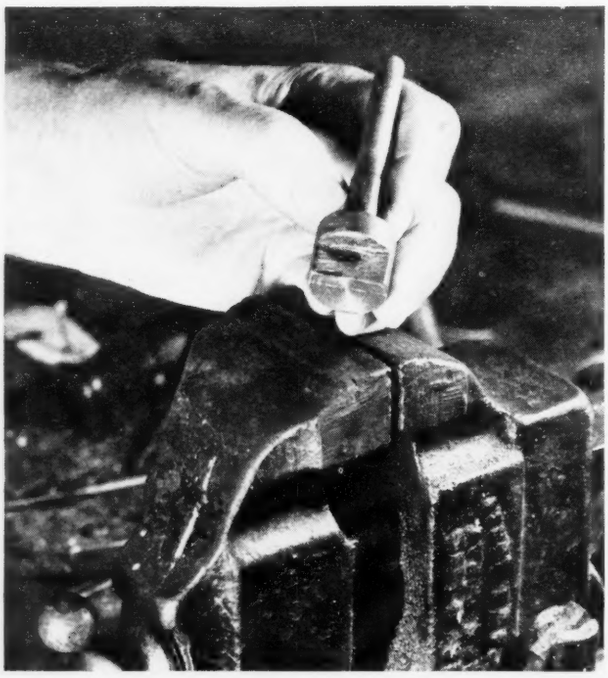
We made a further refinement by using disconnectors to permit connecting both sets of smaller breakers to one master breaker while the other master breaker is being checked or repaired.

Hibbing, Minn. A L BENNETT

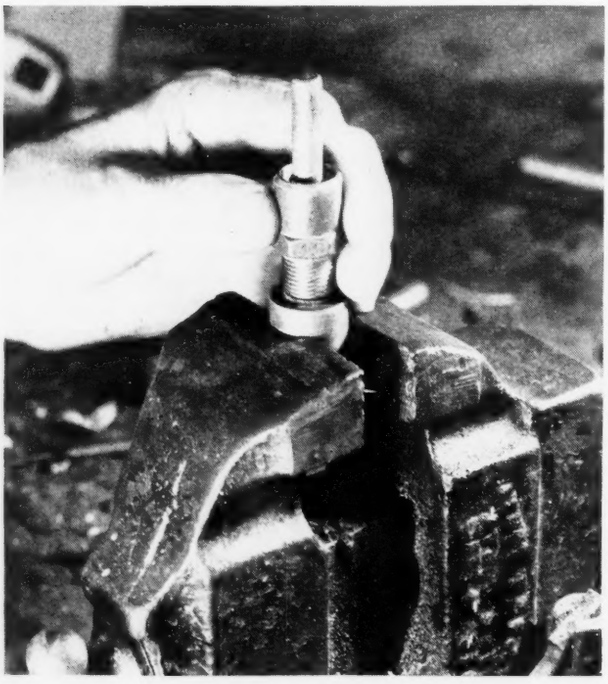

Tie bus
Normally open tie switch
100,000-kva auxilliary master breaker
100,000-kva street-light master breaker
Dis-connects
25,000-kva breaker
To main station bus
Station-circuits each having disconnects and a 25,000-kva breaker
Street-light circuits each having disconnects and a 25,000-kva breaker
To main station bus

HOW TO SOLDER TERMINALS ON TUBING

FLEXIBLE METAL TUBING finds a wide variety of uses in the power plant. The sections can be purchased in any desired length with terminals attached, but sometimes a considerable saving can be made by buying the tubing in long lengths and soldering the terminals yourself. There is a little trick to doing the job which is explained in the following photos. This method was developed by R Boettinger, and is used in the plant where he is chief engineer.

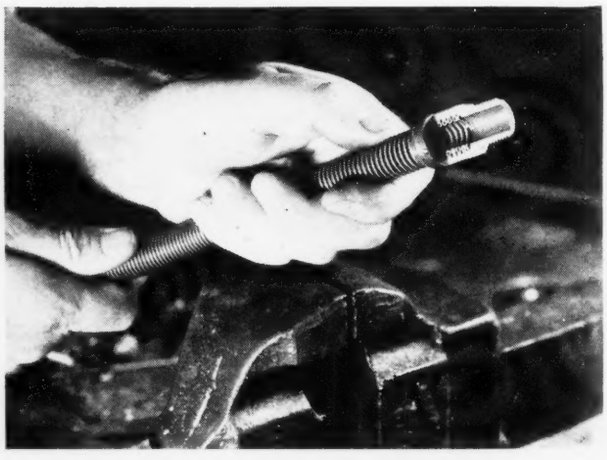


1 **Make a jig on which to support the terminal and tubing for soldering. Aluminum is the best material for this jig, and the more oxide on its surface the better, so that the solder will not stick to it. In the absence of aluminum, use steel, but make sure that its surface is oxidized or oily so that the solder will not stick. The hole in the threaded part of the terminal is larger than the inside of the tubing; therefore, make the jig to fit both**



2 **Secure the jig vertically in a vise. Clean the inside of the terminal socket for the tubing, and put the terminal all the way down on the jig**

3 **Clean the outside tube edges on the section that goes into the socket, apply soldering paste and put tubing on the jig. Be sure that it bottoms in the socket. Heat the socket with a blow torch until it will melt the solder. Apply solder at top of socket until it no longer flows, and forms a ridge around the top. Let the socket cool a little and the solder will flow in. Repeat the heating and soldering operation until solder will no longer flow into the socket. Wipe the socket clean with a wet cloth. I use 95% tin and 5% antimony solder which melts at 465 F and solidifies at a temperature of 450 F**



4 **If the job is done properly the solder will flow to the bottom of the socket and make a good bond between terminal and tubing as shown**

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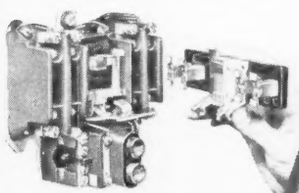

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Boiler-Water Recirculation Cuts Chemical Costs

Kansas refinery saves 22% by returning part of blowdown to hot-process softener. Sixteen-months operating experiences prove results reported here by E D Flickinger

▶ RECIRCULATION OF BOILER WATER was first described in foreign papers more than forty years ago.* It has not been popular in this country until the past few years because it does not apply to all types of water** and because it requires a close check on feedwater and boiler-water concentrations. Recirculation is particularly well adapted to lime-soda softening systems where the raw-water hardness is mostly in the bicarbonate form and the dissolved solids other than calcium and magnesium compounds are low.

Recirculation is practiced for two separate objectives. One method has been to inject one or two percent of boiler water into feedwater to raise the pH value enough to prevent corrosion in economizers, feed pumps and piping.† The second type is applicable to plants using hot-process softeners. Where alkalinities, rather than total solids, are the limiting factor in governing the amount of blowdown, a portion of the blowdown water can be returned to the softener†† to reduce chemical consumption and makeup water and to effect a heat saving.‡

The latter type of recirculation is possible because the sodium phosphate internal treatment involves the addition of an extra amount of sodium alkalinity to the boiler water. This alkalinity becomes available for recirculation as shown by the following equation:

(1) $2\ Na_3PO_4 + 3\ CaCO_3 \rightarrow Ca_3(PO_4)_2 \downarrow + 3\ Na_2CO_3$

Each lb of trisodium phosphate adds 0.97 lb of sodium carbonate to the water within the boiler.

Many operators use acid phosphates to reduce alkalinity, but even monosodium phosphate produces a net increase of sodium alkalinity:

(2) $2\ NaH_2PO_4 + 4\ NaOH \rightarrow 2\ Na_3PO_4 + 4\ H_2O$

(1) $2\ Na_3PO_4 + 3\ CaCO_3 \rightarrow Ca_3(PO_4)_2 \downarrow + 3\ Na_2CO_3$

(3) $3\ Na_2CO_3 + 3\ H_2O + Heat \rightarrow 6\ NaOH + 3\ CO_2 \uparrow$

A comparison of equations (1), (2) and (3) shows that two molecules of monosodium phosphate destroy four molecules of sodium hydroxide but the series of reactions result in the creation of six new ones, a net increase of two molecules of sodium hydroxide or one molecule of sodium carbonate. In other words, every lb of monosodium phosphate added to the boiler forms 0.44 lb of sodium carbonate as a byproduct of softening reactions.

In localities where the raw-water hardness is almost entirely in the bicarbonate form, the sodium alkalinity added to the boiler water through the use of phosphate can entirely displace the use of soda ash if a substantial proportion of the blowdown is returned to the softener. If this is the case, and if alkalinity is still the limiting factor on the amount of blowdown, it may even be advantageous to add calcium sulphate to the softener, especially if sodium sulphate is being added to control embrittlement ratios.

Refinery Boilers

At the oil refinery, six boilers have a total rated output of 122,000 lb per hr at 160-lb pressure. Five boilers are usually sufficient to supply normal demand, the remaining unit standby.

During the summer of 1939, continuous blowoffs were installed on each boiler and connected to a return header. Fig. 1 illustrates operation prior to the introduction of recirculation; Fig. 2 shows conditions after the change. In both cases the water analyses are typical but not necessarily average. The amount of chemical used, however, represents actual consumption averaged over 14 months before and 16 months after the change. The sludge blowoff from each boiler

(*Continued on page* 120)

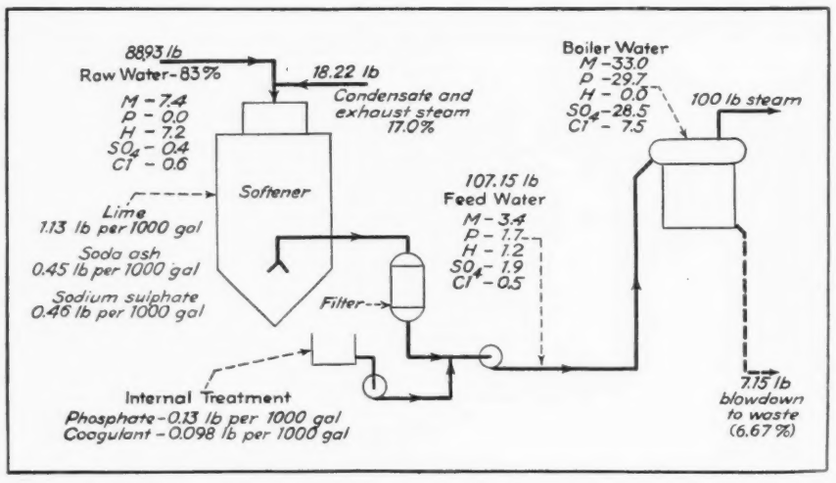


Fig. 1—Prior to the start of recirculation, six 160-lb boilers were supplied with softened and treated water. Average chemicals and typical water analyses are shown

* In 1897 M Rossel, professor at the University of Berne, presented a paper before the Second International Congress of Applied Chemistry in Paris, describing the process.

** POWER, 70, 442–3 (1929).

† *Combustion*, 10, No. 12, 27–33 (1939).

†† The operation is based on the fact that excess soda ash from the softening reactions enters the boiler with the feed water, and under the increased temperature partially breaks down into caustic soda according to the equation:

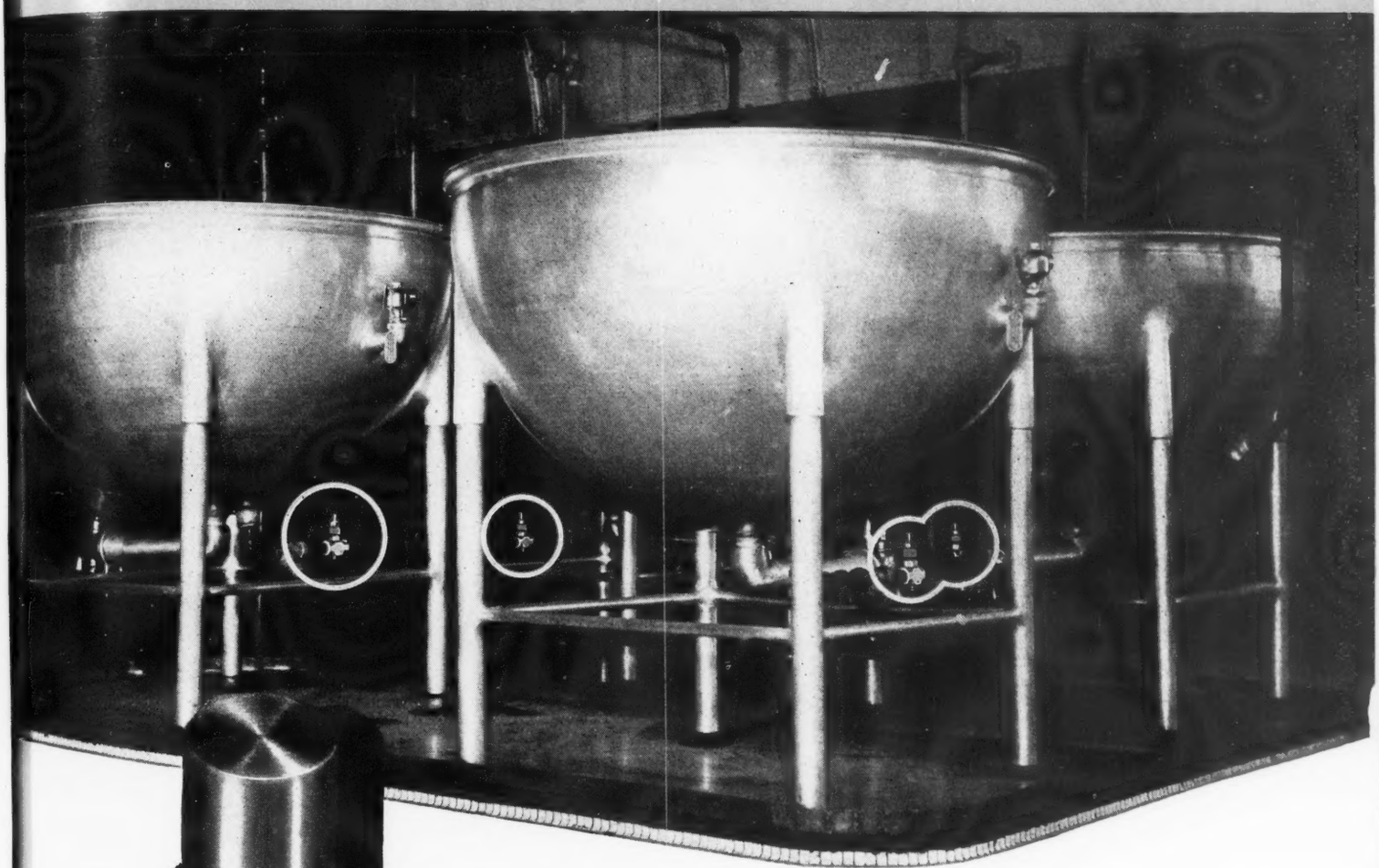
$$Na_2CO_3 + H_2O + Heat \rightarrow 2\ NaOH + CO_2 \uparrow$$

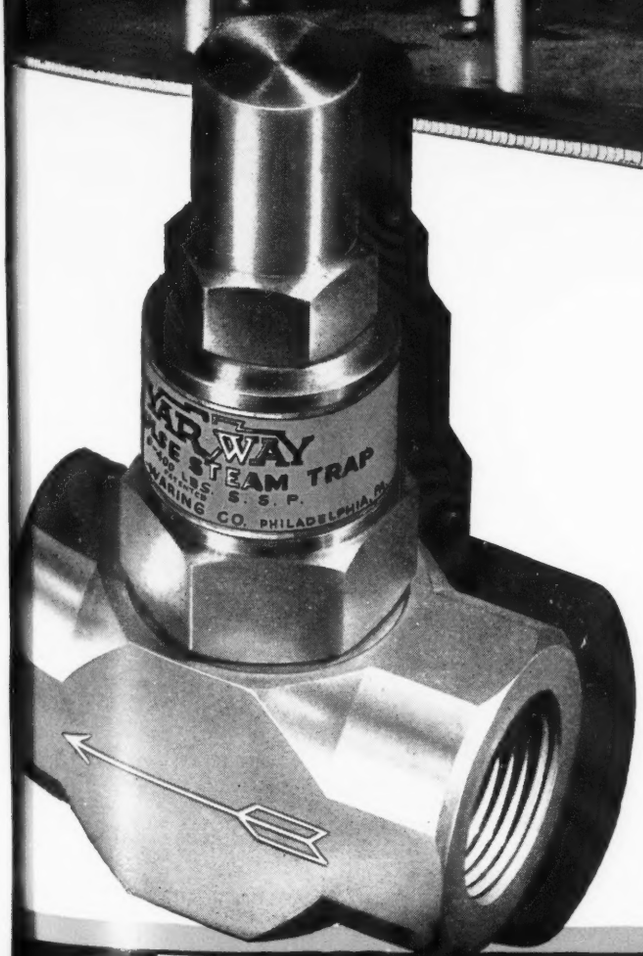
The caustic soda formed and the soda ash remaining are available for treating make-up water in those instances where total solids within the boiler can be increased without causing foaming or priming. The caustic soda replaces an equivalent amount of lime and forms sodium carbonate as a by-product, the latter further reducing the amount of soda ash which must be added to the chemical tank.

$$Ca(HCO_3)_2 + 2\ NaOH \rightarrow CaCO_3 \downarrow + Na_2CO_3 + 2\ H_2O$$

‡ *Combustion*, 11, No. 3, 26–32 (1939).

Rx for Quick Cooking at North Carolina State Hospital





YARWAY IMPULSE TRAPS

YARWAY IMPULSE TRAPS have put new life in many a "sick", sluggish, water-logged kettle. In fact they are "good medicine" for the profitable operation of steam equipment of all kinds because their *quicker heating* and *greater sustained heating efficiency* speed up production and save fuel.

Install a Yarway Impulse Trap or two and let them prove what they can do for you. See how its *small size* saves space. How its *light weight and straight through piping* make installation easy. How its unique design, with *only one moving part*, and its rugged *bar-stock construction*, cuts maintenance costs. Then too, there is *no need to change valve or seat for widely varying pressures.*

And when you consider that their purchase is usually no more than the cost of repairing an ordinary trap—why not get Yarway performance for *your* money?

A nearby Mill Supply Dealer handles Yarway Traps and will be glad to serve you. Or write for Catalog T-1735.

YARNALL-WARING COMPANY, 100 Mermaid Avenue, Philadelphia

YARWAY IMPULSE STEAM TRAP

Boiler-Water Recirculation Cuts Chemical Costs (Continued from page 118)

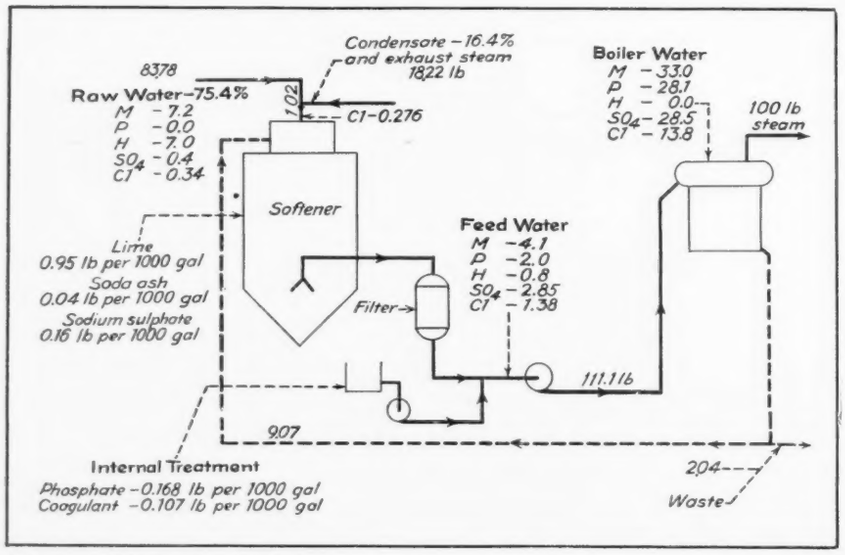


Fig. 2—Addition of recirculation line and continuous-blowdown arrangement resulted in decreased use of chemicals, less makeup and a heat saving

is a manual operation performed once every 12 hr and is not shown on the diagrams.

Recirculation, from September, 1939, to December, 1940, produced the commercial results shown in Table I. The total lime consumption with recirculation was 130,000 lb for the 16 months. Without recirculation, based on Fig. 1, it would have been 164,000 lb. The consumption of other chemicals is also shown in Table II which shows actual use for the period compared to calculated values of what would have been required for the same months on the basis of 14 months records without recirculation. Chemical costs shown include freight.

A water saving was accomplished through reduction in blowdown. Actual use for the 16 months was 136 million gal; without recirculation, 145 million gal would have been required.

Less fuel was burned due to the reduced amount of blowdown with consequent lower makeup amounting to a calculated net value of 16.7 Btu per lb of steam. At 70% boiler efficiency and 55-cents-per-bbl oil, the saving amounts to nearly $2700.

Recirculation has completely eliminated the use of soda ash during normal operation at this plant. Boilers are charged daily with an average of 48 lb of a mixture containing 70% monosodium phosphate and 30% disodium phosphate. The reaction within the boiler produces 25.4 lb of sodium carbonate.

Since the blowdown amounts to only about 2% and since very little sodium carbonate is consumed in the external softening reactions, the sodium alkalinity furnished by the phosphate recycles to such an extent that it becomes the controlling factor in the amount of blowdown. The possibility of replacing sodium sulphate at least in part by whatever amount of calcium sulphate is necessary to reduce sodium alkalinity to a point where the chloride content will be the controlling factor is still under consideration. This will further reduce blowdown to waste, use of water, chemicals and heat.

The continuous blowdown piping was connected in such a manner that each individual blowoff or any part of it could be either returned to the softener or blown to waste. Prior to recirculation the boilers were hand-blown to waste at top and bottom once every six hr. Afterwards, the top manual blowoff connections were removed and the bottoms blown every 24 hr. Under this program there was still too much sodium alkalinity and a cycle of sludge blowoff every 12 hr with 18% of continuous blowoff to waste balanced the system.

The increased cost of internal treatment, Table I, was caused primarily by the continuous blowoff system rather than by recirculation. Other things being equal, recirculation can reduce the quantity of phosphate required because higher feedwater alkalinities can be carried. The latter more than offsets the disadvantage that an extra amount of hot feedwater (3.7%) is consumed containing some hardness that must be removed by internal treatment. Increasing the rate of recirculation prevents the boiler-water alkalinity from rising with that of the feedwater.

Before recirculation was begun, the internal treatment was jetted into the suction of the boiler-feed pump once every three hours, care being taken to make half the injections immediately following the manual blowoffs, which, as mentioned previously, were carried out every six hr. After recirculation began, and with continuous blowdown, internal treatment was added automatically for four minutes every hour by a small time-switch-controlled motor-driven pump. The latter operation has avoided escape of phosphate before reaction with incoming boiler feedwater without resulting in feedline deposits that accompany continuous treatment due to precipitation of hardness before the feedwater reaches the boiler drum. Since this change, the cost of internal treatment has dropped below that of the months preceding the start of recirculation.

TABLE I—CALCULATED SAVINGS

Reduced cost of chemicals	22.1%	$1777
(a) *Reduced cost of external treatment*	61.8%	
(b) *Increased cost of internal treatment*	9.2%	
Reduced cost of water	5.8%	$420
Potential fuel saving*		$2679
Added pumping required	3.7%	

* At times the available exhaust steam exceeds heater requirements. Calculation assumes all heat saving can be utilized.

TABLE II—CHEMICAL REDUCTION FOR 16-MONTH PERIOD

	Lime	*Soda Ash*	*Sodium Sulphate*	*Phosphate*	*Coagulant*
No recirculation, lb calculated	163,705	65,192	66,641	18,833	14,197
Recirculation, lb—actual	129,640	5,459	21,834	22,926	14,601
Saving—lb	34,065	59,733	44,807	—4093	—401
Cost—cents per lb	0.583	1.57	2.35	8.0	21.0
Saving—dollars	198.60	937.81	1,052.96	—327.44	—84.81

GAS ATTACK

Scovill's 3-Way Service Ends Hidden Threat to Condenser Tube Life

SERVICE IN MEN. Destructive action from an unknown source was causing consistent failure of this plant's Admiralty tubes — and the failures always occurred at the same definitely localized spots. Scovill consultants examined the installation and sent samples of the metal to Scovill's laboratories for analysis.

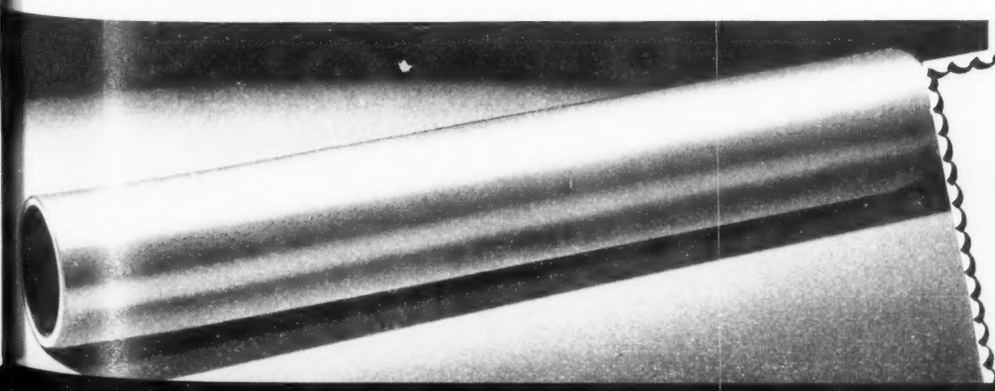
SERVICE IN METALS. Analyses indicated chlorine in a ferric chloride solution, dripping onto Admiralty tubes, severing them from the tube sheet. After thorough plant investigation, and location of chlorine leakage, Scovill recommended a few simple installation changes which ended this costly, chronic trouble once and for all.

SERVICE IN MANUALS. Thus, into a Scovill manual went another page of practical Condenser Tube experience, available to every Scovill customer. Write today for *your* free sample Condenser Tube Booklet, addressing 13 Mill Street, Waterbury, Connecticut.

SCOVILL CONDENSER TUBES
one product . . . three services

- **SERVICE IN MEN**
- **SERVICE IN METALS**
- **SERVICE IN MANUALS**

Scovill, for many years a regular source of supply for the United States Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable and part of the price paid for national defense.



Masters of Metal

Scovill

MANUFACTURING COMPANY

WATERBURY, CONN.

Watts Bar Steam Plant to be on Line 18 Months after Authorization

Use of proved equipment and simplified design speeds construction and reduces preliminary operation time. G R Rich and R T Mathews, in ASME paper, describe new TVA station

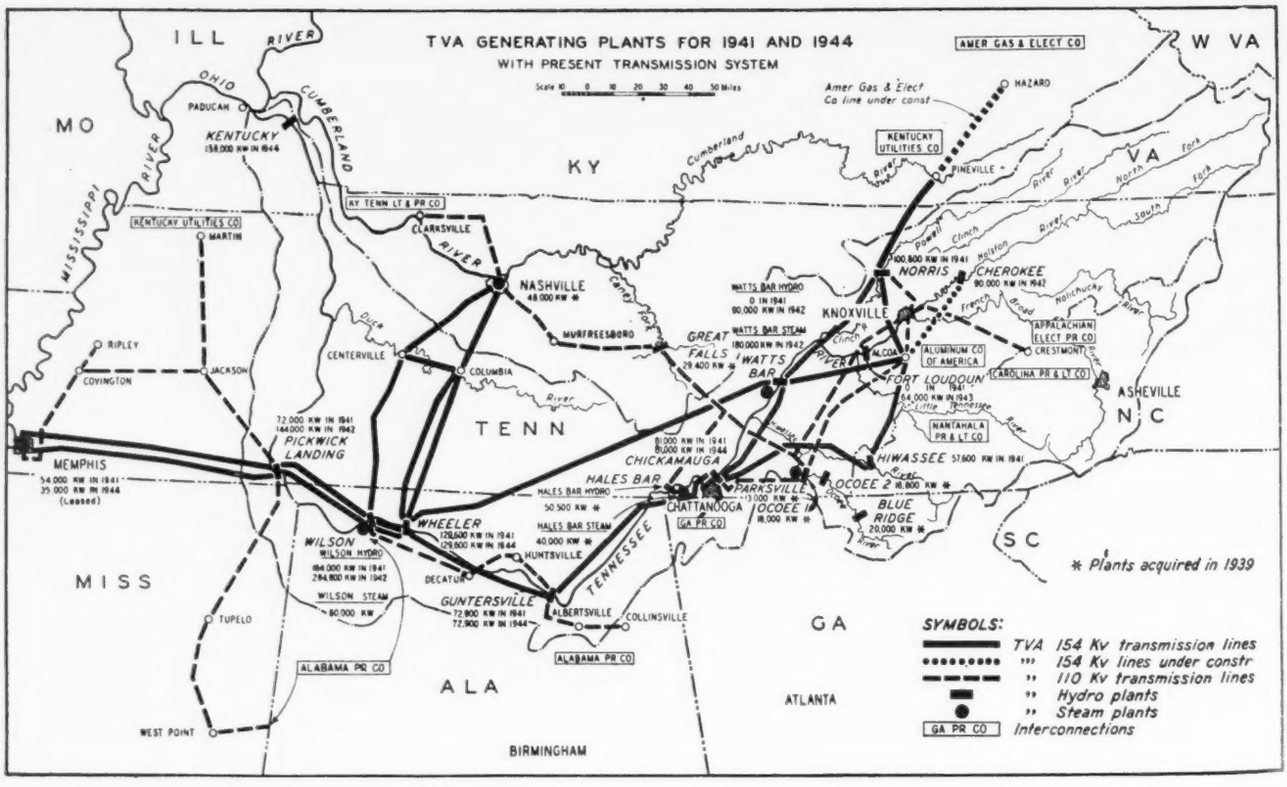
▶ To insure adequate power for production of defense materials, Congress authorized on July 31, 1940, construction of the first 120,000 kw of a 180,000-kw steam station at Watts Bar Dam, near Spring City, Tenn. According to a paper by G R Rich, Tennessee Valley Authority, and R T Mathews, Charles T Main, Inc, presented at the Louisville meeting of the ASME, October 12–15, the first section will be completed in February 1942 and the 60,000-kw addition, authorized April 5, 1941, will be finished in October, 1942. This plant is expected to operate on base load until the national emergency is past.

With only 18 months from authorization to completion, the time element controlled the design and led to selection of proved equipment to speed construction and reduce preliminary operation to a minimum. In addition, the design had to fit the TVA program for navigation and flood control in the Tennessee Valley, which calls for a power system having, in 1944, 1,408,000 kw total installed rated hydro capacity and approximately 380,000 kw steam capacity, of which 200,000 has been obtained by lease or acquisition and 180,000 kw is to be added at Watts Bar.

Analysis of system characteristics, for both wet and dry years, indicated: (1) that the Watts Bar plant will operate approximately 45% of the time or 4000 hr per year, (2) that availability of idle hydro capacity when steam plants are running makes outage of steam units less serious than in a predominantly steam-power system, and (3) that deficiency of power in the east Tennessee area and balanced use of existing transmission-line capacity pointed to Watts Bar as the best site.

At Watts Bar, East Tennessee and Kentucky coals are available at lower cost per Btu than in other load-center areas of TVA. Sufficient cooling water can be had any period of the year from Watts Bar reservoir. A 3500-ft transmission line will tie the steam plant to the existing system, which has adequate line capacity to most major load centers (see map below). Topographic features and foundation conditions, plus possibility of reducing construction cost by use of existing Watts Bar Dam construction facilities, also pointed to choice of this site.

Lower first cost of 60,000-kw units led to selection over 40,000 machines. Use of larger units does not seriously affect spinning- or standby-reserve requirements because the largest hydro unit is rated at 57,600 kw and the largest steam unit at 60,000 kw. Motoring hydro units not needed for energy as synchronous condensers makes spinning reserve inexpensive on TVA. Experience shows such units can pick up full load in 8 sec. Analysis indicates that the only effect of forced steam-unit



HERE *Today . . .*

GONE TOMORROW

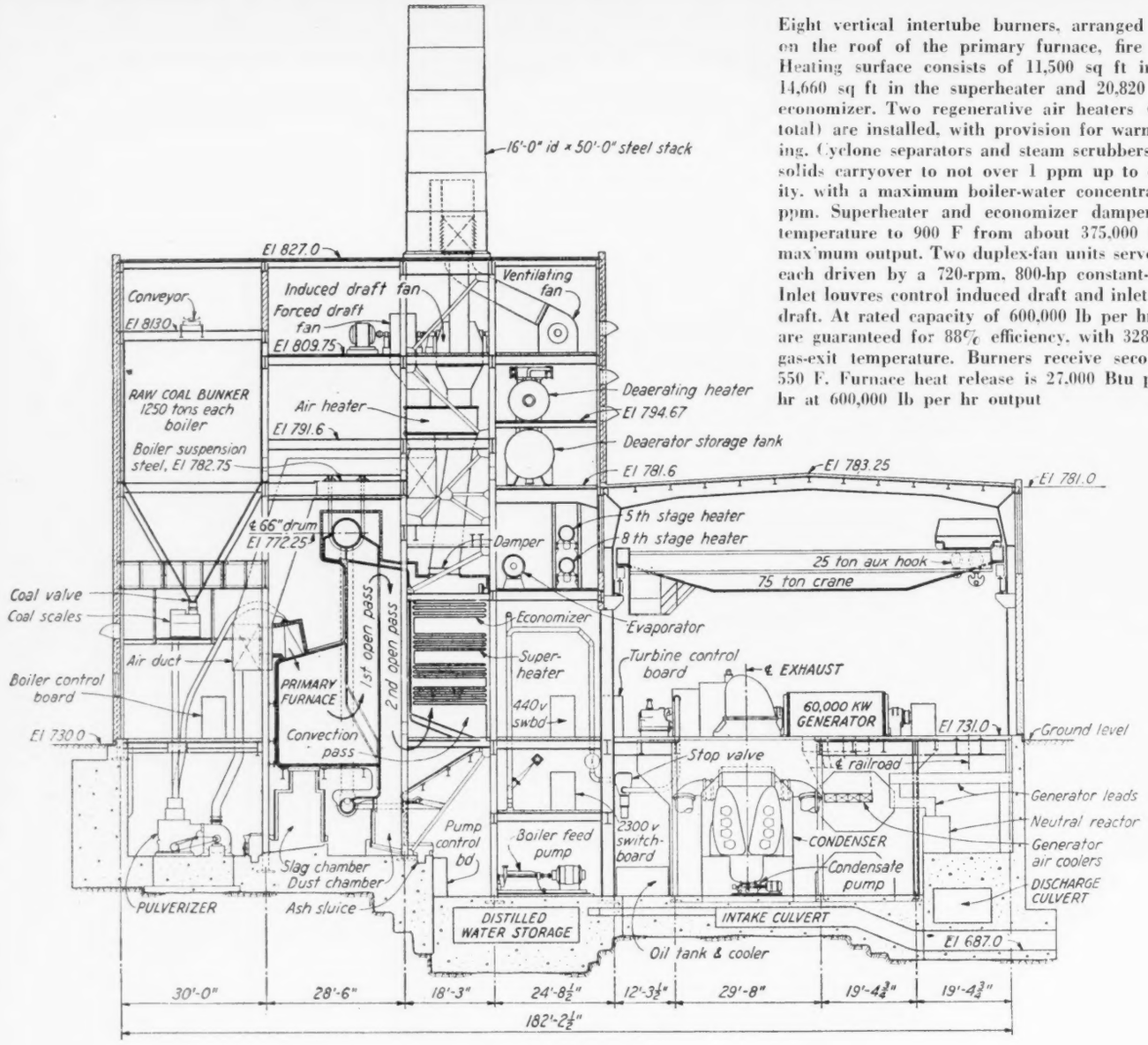
CONTINUOUS movement of huge quantities of water treatment materials through the Nalco plant requires timing scheduled almost to the minute. Average interval, from raw chemicals to finished products, is three days. "Here today, and gone tomorrow" is no figure of speech . . . it is a constant challenge to the men and machines behind the Nalco System.

This speed is now more important than ever. A recent survey showed that over 95% of the entire Nalco output is being used at plants whose products are essential to the Defense Program . . . Plants where the Nalco System is vital in keeping boilers and other power equipment up to maximum operating efficiency *all the time.*

Photos in National Aluminate Corporation plant, Chicago, Ill.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place **Chicago, Illinois**
Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

the Complete Water Treating Service *Nalco*



Eight vertical intertube burners, arranged in one row on the roof of the primary furnace, fire each boiler. Heating surface consists of 11,500 sq ft in the boiler, 14,660 sq ft in the superheater and 20,820 sq ft in the economizer. Two regenerative air heaters (90,000 sq ft, total) are installed, with provision for warm-water washing. Cyclone separators and steam scrubbers reduce total solids carryover to not over 1 ppm up to design capacity, with a maximum boiler-water concentration of 3250 ppm. Superheater and economizer dampers hold total temperature to 900 F from about 375,000 lb per hr to max'mum output. Two duplex-fan units serve each boiler, each driven by a 720-rpm, 800-hp constant-speed motor. Inlet louvres control induced draft and inlet vanes forced draft. At rated capacity of 600,000 lb per hr, the boilers are guaranteed for 88% efficiency, with 328 F air-heater gas-exit temperature. Burners receive secondary air at 550 F. Furnace heat release is 27,000 Btu per cu ft per hr at 600,000 lb per hr output

outage will be reservoir depletion, which can be restored by increased steam operation. The only exception occurs during flood periods when low head reduces capacity of run-of-river plants, and steam handles the peaks.

Low fuel cost and predicted normal low operating hours made pressures and temperatures above the 850-lb 900-F conditions selected uneconomical. A single 600,000-lb-per-hr boiler supplies each turbine-generator but it is expected that one boiler can produce 700,000-lb per hr when the other is out of service and two turbines must be served. Cross-connections between main-steam and feedwater systems for the first two units are for emergency use only; the third unit will be cross-connected in a like manner to a future fourth unit.

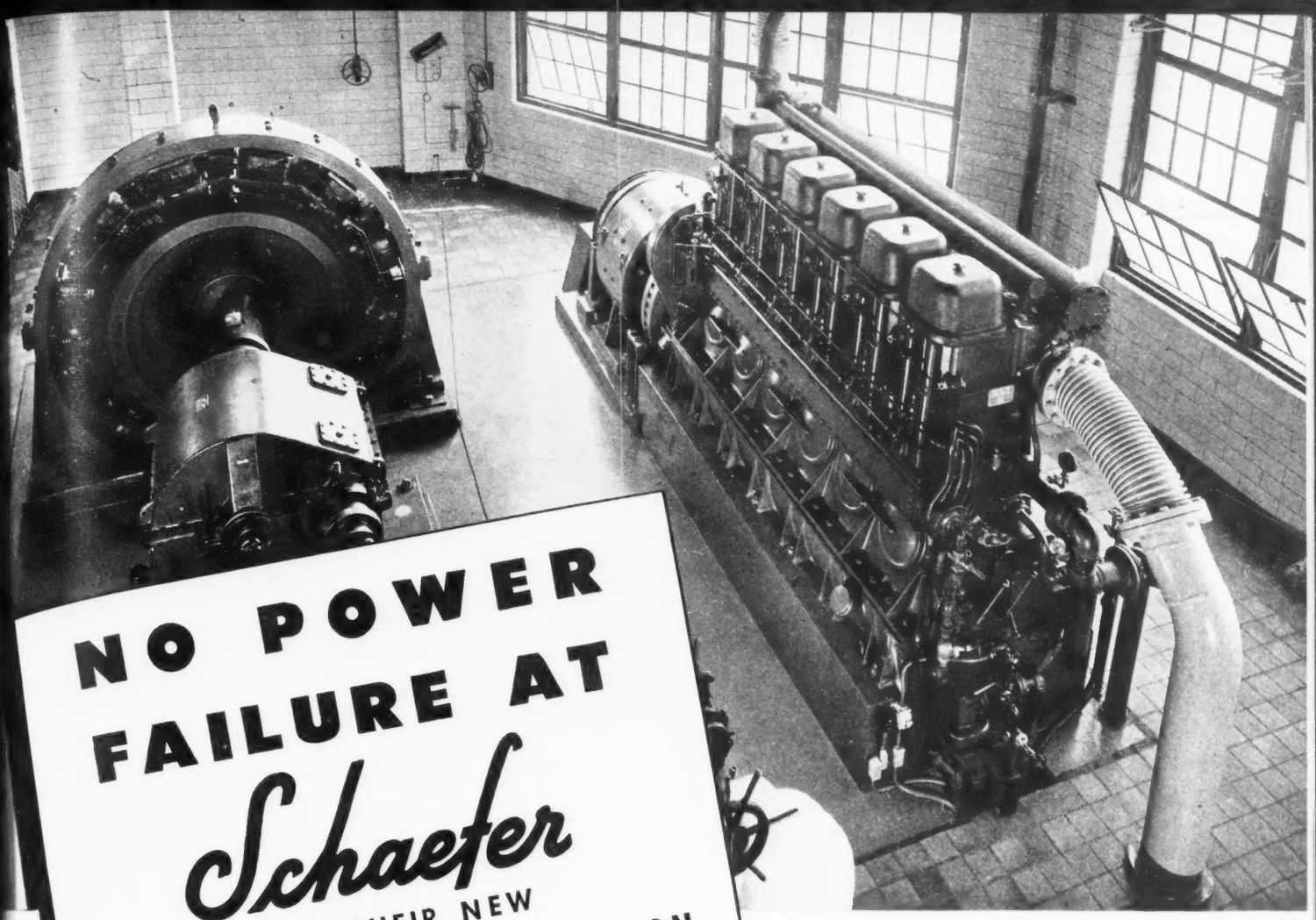
Fourteen turbine control valves, ten admitting steam to first-stage nozzles and four bypassing steam to the third stage to increase steam flow for outputs over 58,000 kw, produce a relatively flat steam-rate curve between 40,000 kw and full output. Low condenser vacuum will automatically trip the turbine stop valve, thus eliminating atmospheric relief valve and piping. An explosion diaphragm in the exhaust hood protects against failure of the tripper.

Water circulates through the 40,000-sq-ft single-pass divided-waterbox condensers by gravity flow from penstocks above the dam. The resulting loss of hydro energy is less costly than pumping and the gravity-flow arrangement avoids the expensive deep condenser pit that would have been required by the possible variation of 43 ft in the Watts Bar tailwater.

The four turbine bleed points supply, respectively, a low-pressure closed heater, a deaerator, and two high-pressure heaters; the high-pressure bleed also supplies an evaporator handling Tennessee River makeup water. The first of the two high-pressure heaters acts as an evaporator condenser. Based on manufacturer's guarantees and predicted summer reservoir-water temperatures, a net plant heat rate of 11,800 Btu per kw hr will be achieved at 66,600 kva generator output.

Other papers of interest to power engineers presented at the Louisville meeting include: "Evolution of Furnace and Superheater Design" by William J Vogel; "A Method of Estimating the Circulation in Steam-Boiler-Furnace Circuits" by A A Markson, T Ravese, and C G R Humphreys; "Causes of Mortality of Smoke-Abatement Campaigns" by T A Marsh; "Essentials of a Smoke-Abatement Program" by H K Kugel; "Flood Protection of Canal Street Station" by A G Rosenbaum; "Turbines for Power Generation from Industrial Process Gases" by John Goldsbury and J R Henderson; and "The Corrosion of Unstressed Specimens of Steel and Various Alloys by High-Temperature Steam" by H L Solberg, G A Hawkins, and A A Potter.

For further information or copies of these papers write to Publications Dept. American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y.



NO POWER FAILURE AT *Schaefer* WITH THEIR NEW DIESEL-STEAM COMBINATION

Power failure problems were eliminated at The F. & M. Schaefer Brewing Company's Brooklyn plant when this new 6-cyl., 600-hp De La Vergne diesel engine was recently installed alongside the steam turbine also shown. Thus the inherent dependability of diesels in the ultimate emergency is again exemplified.

"Two necessary services will be performed by the diesel," says Fred Ophuls, consultant and designer of the plant, "The first of these is to meet the demand for current for lighting and operation of small motors over weekends; the second is the ability to continue the racking and bottling of the beer, should some emergency force the steam plant to shut down. Our experience with the engine seems to indicate that we have been able to fulfill these requirements with the unit we have installed."

Your best assurance for an uninterrupted power supply is a De La Vergne diesel. Known throughout the country for their dependable and economical operation, De La Vergne diesels are available in sizes from 200 bhp to 1,500 bhp. Let De La Vergne engineers investigate your power problem.

Baldwin De La Vergne SALES CORP.

SUBSIDIARY OF THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

BLW THE BALDWIN GROUP

Iron and Steel Engineers Present Diversified Program

National defense problems, mechanical-power transmission equipment, automatic combustion control, power applications and lubrication considered at three-day AISE convention

▶ The Association of Iron and Steel Engineers held its 37th Annual Convention and Iron and Steel Exposition Sept 23 to 25, with the Public Auditorium, Cleveland, Ohio, as headquarters. The convention came at a time when the iron-and-steel industry is working at top speed 24 hours a day to meet the demands of the national defense program. All activities of the convention, therefore, emphasized the problems arising from the record production rate of the industry.

The convention was highly successful, with approximately 8,000 members and others interested in iron-and-steel-production problems registering. In a busy 3-day program, 27 technical papers were presented at 9 sessions, with a trip to the Otis Steel Co's Riverside plant, where the power equipment and machinery associated with a wide line of iron-and-steel production was seen in operation. Over 100 power and steel-making-equipment manufacturers occupied 36,000 sq ft of space in the iron- and steel-equipment exhibition.

Transmitting Motor Torque

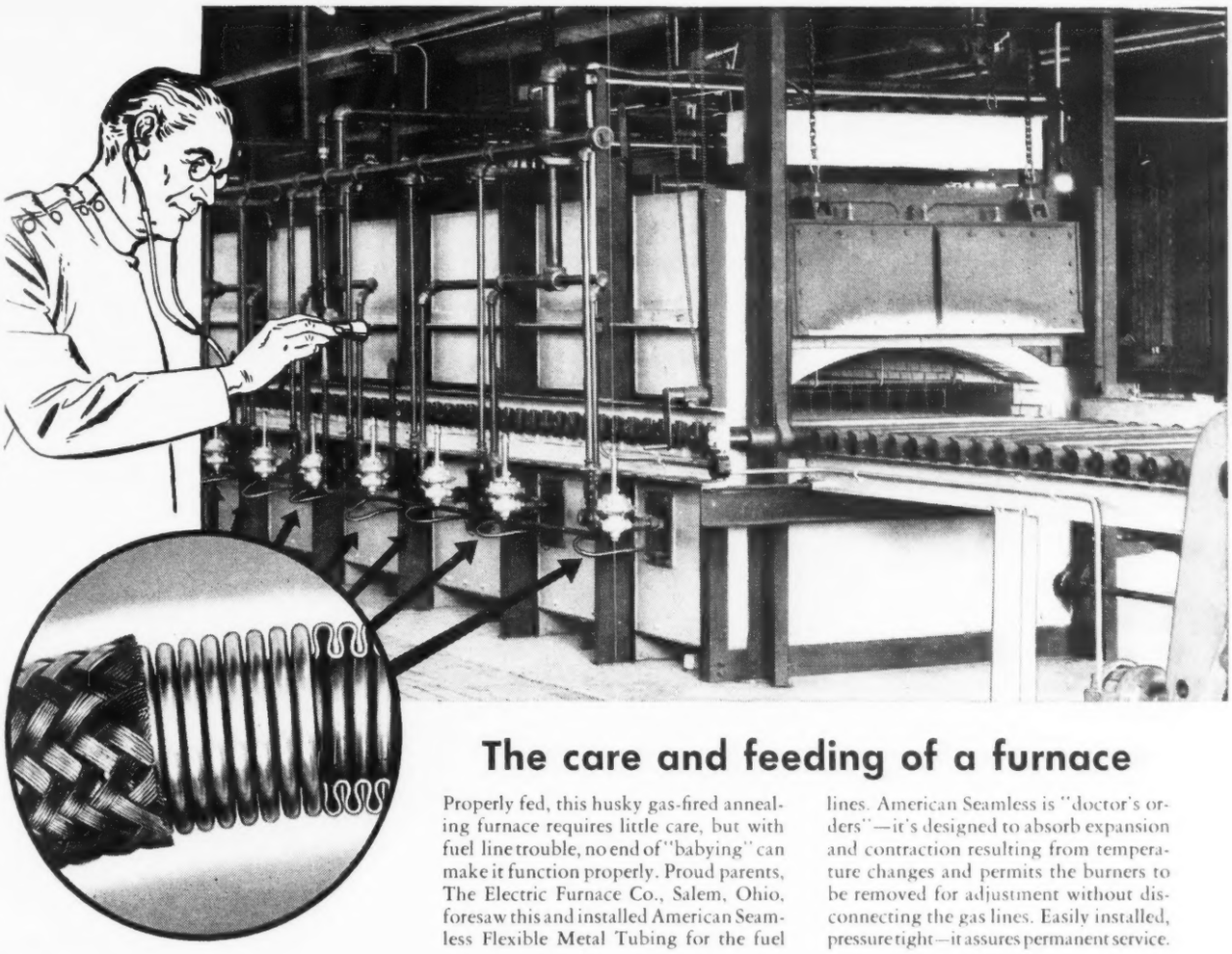
Among the 27 papers presented, the one of most general interest to power engineers was by A M MacCutcheon, vice president, Reliance Electric and Engineering Co. He discussed the problems associated with connecting motors to their loads. "When transmitting motor torque to the driven machine, one of the greatest problems," said Mr MacCutcheon, "is proper alignment of the motor shaft with that of the driven machine." The problem of a sufficiently accurate alignment to give satisfactory results is present in all classes of mechanical-power transmitting equipment. Even a belt drive must be reasonably well aligned.

Many types of flexible couplings have been developed to provide for inevitable misalignment. If there is any misalignment, there is an undesired relative motion between the driving motor and the driven machine. While all types of flexible couplings have been designed to give successful operation with some degree of misalignment, no flexible-coupling manufacturer will deny the wisdom of securing as nearly perfect alignment as is practicable. In an effort to reduce misalignment to a minimum, a type of drive known as "floating power" has been developed.

In this type of drive, the motor is supported directly on the driven shaft, no other support being required for the motor. The motor rotor is mounted on the driven shaft the same way that a coupling is mounted. The stator weight is supported through the motor bearings. Stator rotation is prevented by springs fastened to the motor frame and to a fixed projection on the driven machine base. Alignment cannot be lost between the driven shaft and the driving motor since the driven shaft supports and determines the position of the driving rotor. This is an interesting development and is being employed in a large steel mill. First cost is somewhat higher, but it is believed that maintenance will be decreased.

During recent years measurement and elimination of noise and vibration due to unbalance have been exhaustively investigated. Many customers are now checking the balance of the motors which they receive, if they are to be used to drive a machine where unbalance will result in poor workmanship. If such a check is made, care should be exercised in making certain that the parts which are mounted on the motor

A M MacCutcheon, engineering vice-president, Reliance Electric and Engineering Co. presenting his paper "Transmitting Torque from Electric Motors" at the opening session of the convention held on Tuesday morning



The care and feeding of a furnace

Properly fed, this husky gas-fired annealing furnace requires little care, but with fuel line trouble, no end of "babying" can make it function properly. Proud parents, The Electric Furnace Co., Salem, Ohio, foresaw this and installed American Seamless Flexible Metal Tubing for the fuel lines. American Seamless is "doctor's orders"—it's designed to absorb expansion and contraction resulting from temperature changes and permits the burners to be removed for adjustment without disconnecting the gas lines. Easily installed, pressure tight—it assures permanent service.

Consider these facts about *American Seamless* ...industry's super flexible tubing!

1. This flexible metal tubing, made from seamless tubes of various workable metals, *has no joints, welds, seams or packing of any kind.*

2. American Seamless in various types of installations both in the laboratory and in the field, has been flexed literally millions of times without sign of failure.

3. Reinforcing metal braids increase the ability of American Seamless to withstand high pressures under severe service conditions—for example, ½" I.D. with two braids, tests to a hydrostatic bursting pressure of 5,000 lbs. per sq. in.

4. Because of its all-metal construction, American Seamless is impervious to the chemical action of oils and the "drying up" effect of intense heat.

Details of the physical properties of American Seamless and other valuable engineering information is contained in our Bulletin No. 40. Illustrations show typical installations; diagrams accompany complete installation instructions. Write for your copy now.

American Metal Hose

ANACONDA

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company

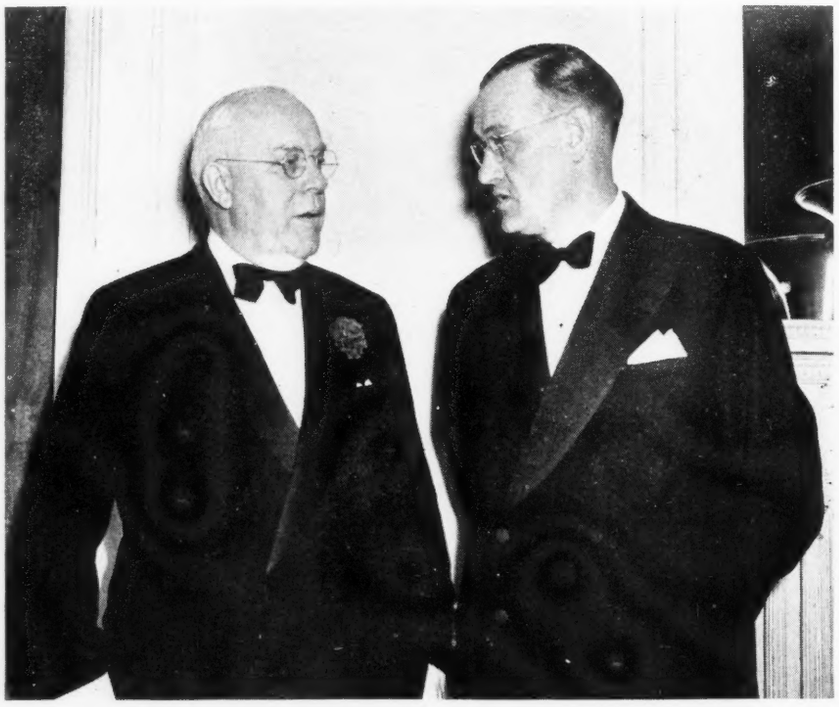
In Canada: Anaconda American Brass Ltd., New Toronto, Ontario

(Continued from page 126)

shaft, such as a pulley, sprocket, gear, coupling or brake wheel, have also been properly balanced.

In one case the motor was condemned, whereas the coupling was badly out of balance. It had been finished all over and was therefore assumed to be in perfect balance. In another case a motor was checked with no key in place, but it had been balanced with a half key on the assumption that the part to be mounted would be similarly balanced before being installed on the shaft of the motor.

Even though the motor and the driven part are both in excellent balance, vibration will be present if they are not accurately aligned. The axis of rotation should always be horizontal. While it is not always the case, it has been frequently demonstrated that a motor in perfect balance with the shaft horizontal will have an appreciable vibration if the shaft be materially displaced from its horizontal position. In a motor-generator set, using the best type of flexible coupling and with both rotors accurately balanced, vibration is apt to be present if there is even a small degree of misalignment.



(Left) E J Kulas, president, Otis Steel Co, and Thomas E. Hughes, newly elected president, Association of Iron and Steel Engineers, talk things over prior to taking their places at the speaker's table for the annual banquet

Steel in National Defense

On Wednesday evening at the annual banquet, attended by over 500 members and guests, E J Kulas, president, Otis Steel Co, spoke on the nation's capacity to produce steel and its importance in national defense. Mr Kulas stated that the underlying strength of a nation in an international conflict such as is now going on may be measured by its capacity to produce steel. Mr Kulas continued by saying: "The fact is that we in the United States today can make nearly as much steel as all of the rest of the world. Our capacity today totals over 86,000,000 tons a year and new capacity now being planned or installed to meet requirements of the defense program will probably boost this figure close to 90,000,000 tons by the end of 1941."

"In 1940, Germany and all the other countries of continental Europe, excluding Russia, made some 42,500,000 tons of steel. Russia produced about 21,800,000 tons, England produced about 15,000,000 tons, and about 13,200,000 tons were made elsewhere in the world, mostly in Japan and Canada."

"These figures tell the story. We have far more steel capacity than any other nation. We can therefore make far more of the implements of defense, and that is the measure of our strength and our security.

"My answer to anyone who has any doubts about the outcome of the present conflict is simply this—Uncle Sam can make over twice as much steel as Hitler."

However, Mr. Kulas warned that "merely to have plenty of steel in this country is not enough. That steel must be transformed into the various types of equipment needed for the defense of the nation and the products needed to maintain peace-time economy."

"We have plunged into an all-out program of national defense and aid to Britain—a program in which production and time is of paramount importance.

"As far as aid to Britain is concerned, the effect of strikes is exactly the same as that of bombs and torpedoes. If a desperately needed shipment doesn't reach Britain in time, what difference does it make whether that shipment is sunk on the high seas or held up by a strike?"

"Now, we cannot eliminate arguments between unions and management. Collective bargaining is in itself a form of argument. Our difficulty is in the failure to provide the proper machinery for handling arguments without stopping production."

It was with considerable pride that, at the Old Timers Club luncheon, attention was called to the recent proclamation issued by President Roosevelt wherein he asked the cooperation of the National Safety Council in a concerted and intensified drive for greater safety. The National Safety Council was founded in 1912 as an outgrowth of the Association of Iron and Steel Engineers Safety Committee, formed 36 years ago in the second year of the association's existence. As a result of the safety committee's work, the steel industry is one of the safest in which to work. The real safety problem insofar as this industry is concerned is not while the employee is on the job, but when he is away. In some plants in the steel industry the off-time accident rate is 8 times as high when the employees are away from work as when they are on the job. Of the 20,080 killed in automobile accidents during the first 7 months of this year, 9500 were industrial workers. To stop this drain on the nation's productive manpower, the National Safety Council has hurriedly mobilized a safety army to prevent, insofar as possible, accidents of all kinds.

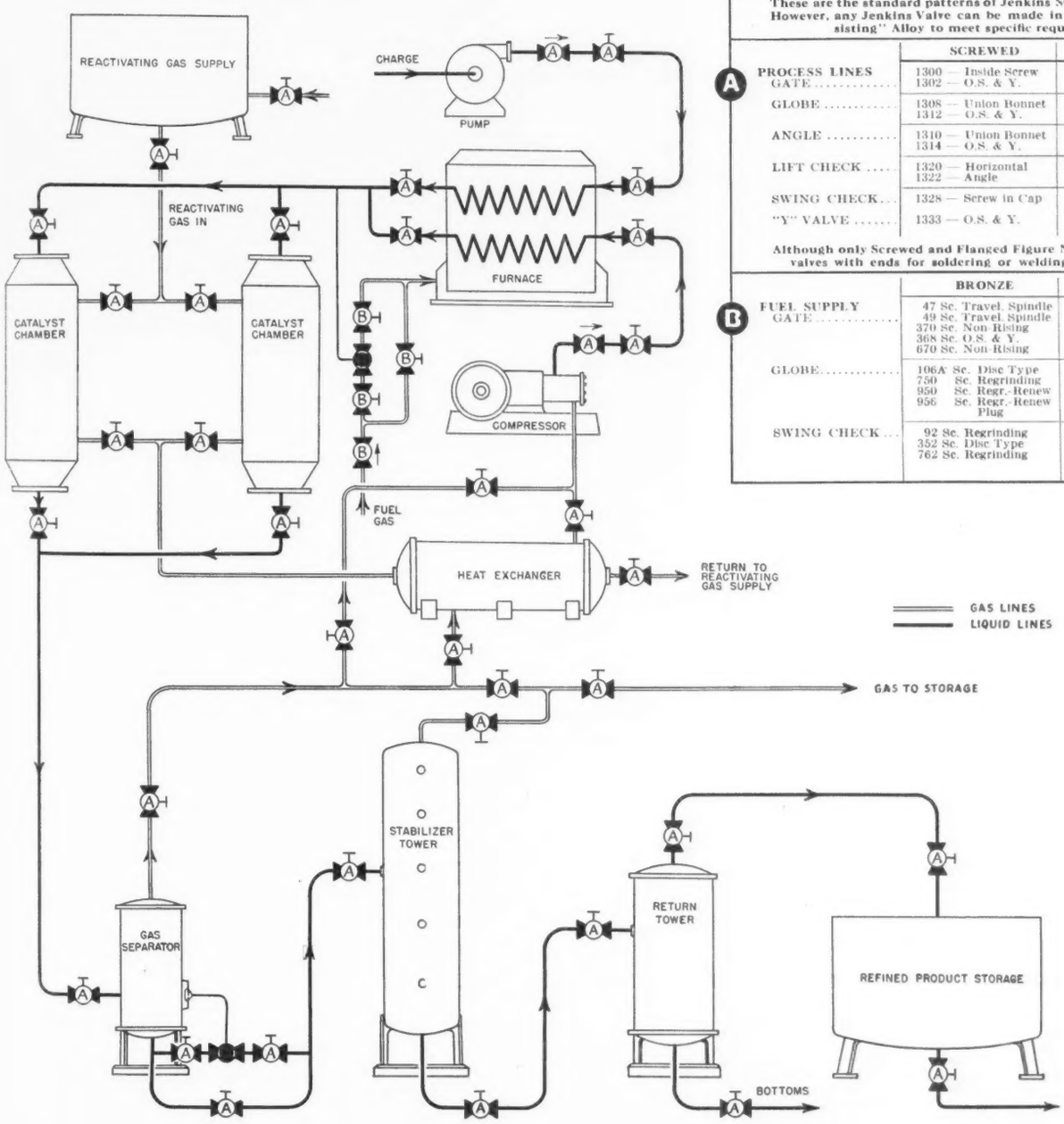
(*Continued on page* 146)

. . TO GOOD VALVE *PRACTICE* . . .

FOR CORROSIVE SERVICES . . .

Jenkins RECOMMENDS . . .

"CRACKING" PLANT



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

These are the standard patterns of Jenkins Stainless Steel Valves. However, any Jenkins Valve can be made in any "Corrosion-Resisting" Alloy to meet specific requirements.

		SCREWED	FLANGED
A	PROCESS LINES GATE	1300 — Inside Screw 1302 — O.S. & Y.	1301 — Inside Screw 1303 — O.S. & Y.
	GLOBE	1308 — Union Bonnet 1312 — O.S. & Y.	1309 — Union Bonnet 1313 — O.S. & Y.
	ANGLE	1310 — Union Bonnet 1314 — O.S. & Y.	1311 — Union Bonnet 1315 — O.S. & Y.
	LIFT CHECK	1320 — Horizontal 1322 — Angle	1321 — Horizontal 1323 — Angle
	SWING CHECK	1328 — Screw in Cap	1329 — Screw in Cap
	"Y" VALVE	1333 — O.S. & Y.	1334 — O.S. & Y.

Although only Screwed and Flanged Figure Numbers are shown, valves with ends for soldering or welding can be supplied.

		BRONZE	IRON
B	FUEL SUPPLY GATE	47 Sc. Travel. Spindle 49 Sc. Travel. Spindle 370 Sc. Non-Rising 368 Sc. O.S. & Y. 670 Sc. Non-Rising	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.
	GLOBE	106A Sc. Disc Type 750 Sc. Regrinding 950 Sc. Regr.-Renew 956 Sc. Regr.-Renew Plug	612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type
	SWING CHECK	92 Sc. Regrinding 352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type

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 # 35
OF A SERIES
designed to help in your selection of
JENKINS VALVES

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Number 111

Conductor Size Selector Chart

TABLE I—ALLOWABLE CURRENT PER CONDUCTOR IN AMPERES

Based on National Electrical Code

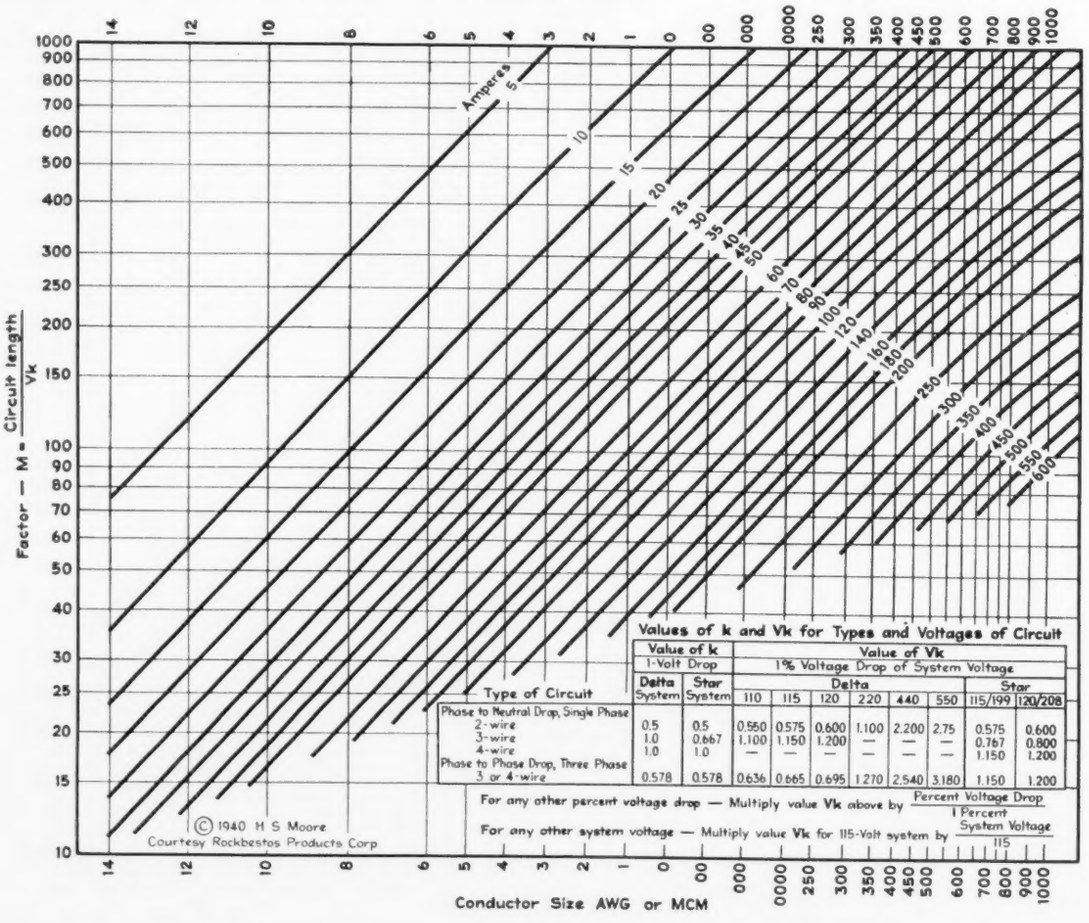
Size AWG MCM	Rubber Type RW Type R	Synthetic Type SN Latex Type RU Rubber Type RPT Type RP	Rubber Type RHT Type RH	Paper Synthetic Type SNA Asbestos Var-Cam. Type AVB Var-Cam. Type V	Asbestos Var-Cam. Type AVA AVL
14	15	18	22	23	28
12	20	23	27	29	36
10	25	31	37	38	47
8	35	41	49	50	60
6	45	54	65	68	80
5	52	63	75	78	94
4	60	72	86	88	107
3	69	83	99	104	121
2	80	96	115	118	137
1	91	110	131	138	161
0	105	127	151	157	190
00	120	145	173	184	217
000	138	166	199	209	243
0000	160	193	230	237	275
250	177	213	255	272	315
300	198	238	285	299	347
350	216	260	311	325	392
400	233	281	336	361	418
500	265	319	382	404	468
600	293	353	422	453	525
700	320	385	461	488	562
750	330	398	475	502	582
800	340	410	490	514	600
900	360	434	519	556	...
1000	377	455	543	583	681

► CHART GIVES WIRE SIZE in American Wire Gage or 1000 circular mils for three single-conductor 600-v insulated cables in iron conduit at 86 F room temperature for any current flow in amperes. Allowable circuit voltage drop can be found for a given circuit length and ampere flow.

For example, find the cable size required to carry 50 amp on a 3-wire single-phase 120-volt branch circuit, 240 ft long with 1% voltage drop. From values on the chart, V_k is 1.2. Factor $M = \frac{240}{1.2} = 200$. Reading from chart, the factor M line for 200 intersects the 50-amp line between wire sizes 0 and 00; thus an 00 cable should be used.

To find the voltage drop for any load for a given circuit length and cable size, find the factor M from the intersection of the conductor-size and ampere-flow lines. Divide the circuit length by the factor M and divide the result by k (not V_k). This gives voltage-drop in volts.

Where chart values exceed allowable current-rating in Table 1, the latter limits should be used. Remember that current-carrying capacities are sharply limited for temperatures above 86 F. Allowance must be made for low power factor, for which consult the National Electrical Code.



Values of k and Vk for Types and Voltages of Circuit

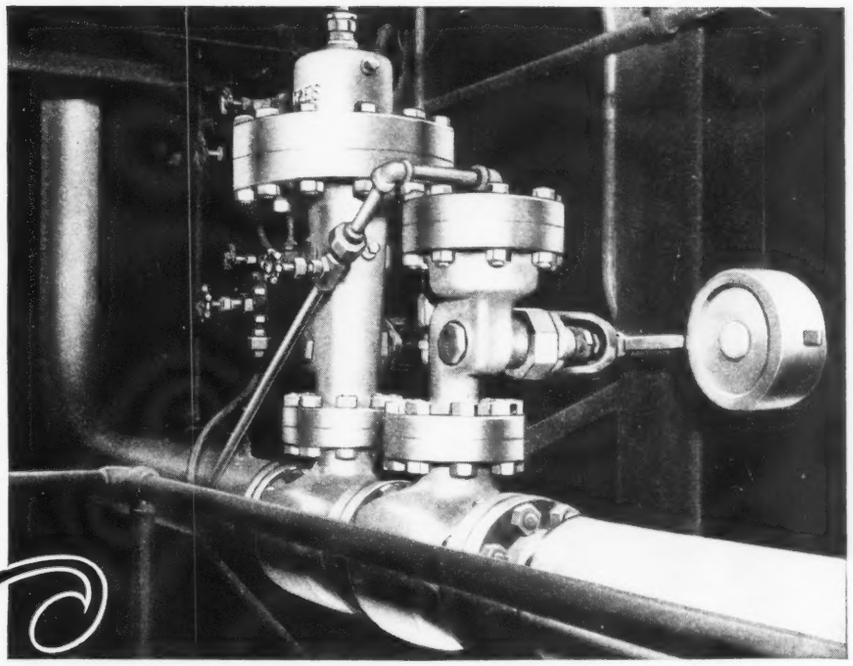
Type of Circuit	Value of k 1-Volt Drop: Delta System	Value of k 1-Volt Drop: Star System	Value of Vk 1% Voltage Drop of System Voltage: Delta 110	Delta 115	Delta 120	Delta 220	Delta 440	Delta 550	Star 115/199	Star 120/208
Phase to Neutral Drop, Single Phase 2-wire	0.5	0.5	0.550	0.575	0.600	1.100	2.200	2.75	0.575	0.600
3-wire	1.0	0.667	1.100	1.150	1.200	—	—	—	0.767	0.800
4-wire	1.0	1.0	—	—	—	—	—	—	1.150	1.200
Phase to Phase Drop, Three Phase 3 or 4-wire	0.578	0.578	0.636	0.665	0.695	1.270	2.540	3.180	1.150	1.200

For any other percent voltage drop — Multiply value Vk above by $\frac{\text{Percent Voltage Drop}}{\text{1 Percent}}$

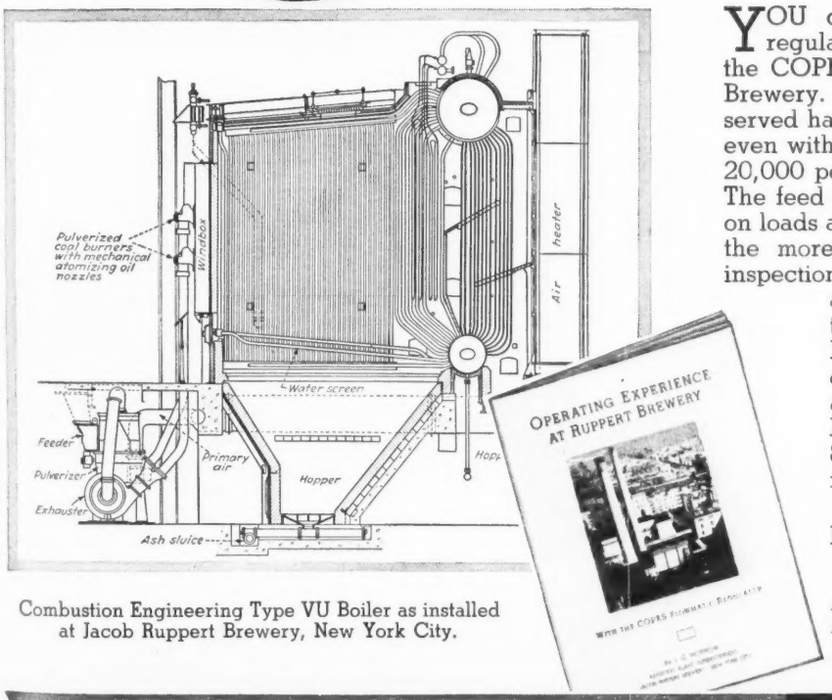
For any other system voltage — Multiply value Vk for 115-Volt system by $\frac{\text{System Voltage}}{115}$

RUPPERT BREWERY

One of Manhattan's "show" plants . . . with three 410-lb. 625-deg. C-E Type VU Boilers producing steam for power, process, refrigeration and heating. Each is designed for 50,000 lb. an hour continuous capacity; 2-hour peak capacity, 70,000 lb. per hour. Normal firing with powdered coal; oil for ratings below 50 percent. Wm. L. Schuler, Plant Superintendent. Burns & Roe, Inc., consultants.



COPES FLOWMATIC HOLDS WATER LEVEL ±1 INCH



Combustion Engineering Type VU Boiler as installed at Jacob Ruppert Brewery, New York City.

YOU couldn't ask for better feed water regulation on a modern 2-drum boiler than the COPES Flowmatic is providing at Ruppert Brewery. Maximum water level variation observed has been within plus or minus one inch, even with steam demands swinging as much as 20,000 pounds per hour within a few minutes. The feed and level control are just as accurate on loads as low as 10,000 pounds an hour as on the more normal ratings. And only routine inspection and care is needed to keep the fully automatic COPES Flowmatic Regulators operating dependably. Mr. J. G. Morrow, Assistant Plant Superintendent, discusses "Operating Experiences at Ruppert Brewery with the COPES Flowmatic Regulator" in illustrated 8-page bulletin 431. Write for a copy now—on your letterhead, please.

NORTHERN EQUIPMENT COMPANY
1111 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves, Desuperheaters

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

POWER LINES

W Le Roy Emmet Dies

William Le Roy Emmet, 82, consulting engineer of the General Electric Co, known for his contributions in the fields of power generation and ship propulsion, died September 26 at Erie, Pa., at the home of his nephew, H L R Emmet, manager of GE's Works there. Mr. Emmet had been ailing from a heart condition.

As early as 1909 Mr Emmet had pointed out that electric ship propulsion was feasible, economical, and practical. He did significant work in developing the steam turbine from the embryonic to the practicable stage, and worked out the Emmet mercury-vapor process of power generation. A total of 122 patents was issued in his name.

Born at Pelham, N. Y., July 10, 1859, Mr Emmet was educated at schools in Canada, New York, and subsequently entered the United States Naval Academy, where he was graduated in 1881.

Mr Emmet first became associated with electrical work in 1887 when he entered the employ of the Sprague Electric Railway and Motor Co. He later went with the Buffalo Railway Co as

W Le Roy Emmet

electrical engineer, and soon afterward accepted a position with the Edison General Electric Co. in the Chicago district. He came to Schenectady in 1892 when the Thomson-Houston Co joined with the Edison General Electric Co to form the General Electric Co.

During later activities, Mr Emmet began his work on the mercury-vapor process, which has since been improved and applied to power generation.

Prior to his achievements in the steam turbine field, he attained prominence through his work in encouraging the use of alternating current, and a number of inventions making possible its practical use stand to his credit. He made many contributions in the field of electrical insulations, inventing varnished cambric cable and several types of transformers.

Mr Emmet's most brilliant accomplishments, however, were as an institutor of new methods and new ideas. A great deal of his most useful work could not be patented nor perhaps even classified as invention.

Mr Emmet was a member of the American Philosophical Society, AIEE, ASME, Society of Naval Architects and Marine Engineers, and of the War Time Consulting Board of the United States. He was also a member of the University and Engineers' Clubs of New York.

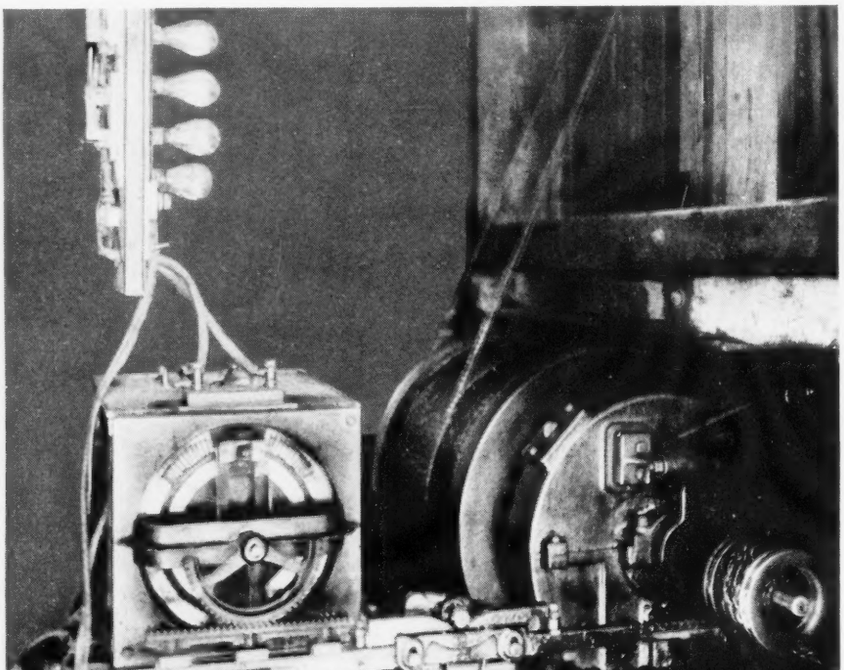
He received the honorary degree of DSc from Union College in 1910, and later the same degree was conferred upon him by Trinity College. He was awarded the Gold Medal at the St Louis Exposition for his work in developing the vertical shaft turbine, the Gold Medal for electric ship propulsion at the San Francisco Exposition and the Elliott-Cresson Medal in 1920.

OBITUARIES

WILLIAM A WESTCOTT, 70, stationary engineer at the Massey Harris Co plant, Batavia, N. Y., died Sept 10 after a short illness. He has a record of nearly half a century as a turbine engineer. For some time prior to his association with the Massey Harris Co, he was at Sibley College, Cornell University and chief engineer for the Ithaca Street Railway.

ROBERT V GOOD, 50, manager of the Philadelphia Works of the General Electric Co since 1936, died September 17 at his home in Drexel Hill, Pa., following a long illness. Mr Good was born in Germany, attended the Royal Technical School at Stuttgart, was graduated in 1911 and came to the United States the same year. In 1913 he joined

(Continued on page 162)



ELEVATOR WITH A HISTORY

The Otis passenger-elevator machine in this photo, installed in 1891 and still in operation in the Nichols Building, Spokane, Wash., is the oldest elevator in the United States; probably in the world. It is a worm-gear drum type with mechanical control, rated 1500 lb at 175 to 200 ft per min, on a lift of 68 ft. It has been in constant service since first installed, and so far as known, the worm and gear have not been changed, although they are now badly worn. The elevator is driven by a dc motor supplied from an ac system through a motor-generator set.

UNSAFE TURNS *plus* EXTRA STRAIN WILL WRECK YOUR *Pipe Lines* TOO . . .

THE DANGER LIES AT THE **TURNS**

Hurtling power and a weak curve played havoc with this express train. Another failure at the turns. (*Acme photo*).

Weld your piping with TUBE-TURN fittings for stronger, safer, trouble-free, "turns"

Many railroad disasters happen AT A CURVE—because that's where strain and wear hit hardest.

Piping systems face the same hazards. Pressure, friction, stress, and erosion punish your lines worst *at the turns*—wherever there is a change in direction.

That's why it is sound engineering to insure the *utmost* safety and strength at these danger points with TUBE-TURN Welding Fittings.

Welding with Tube-Turns gives your plant the assurance and economy of piping systems with longer life, better performance, space-saving layouts and virtually no maintenance interruptions.

Write for helpful Tube-Turns engineering data book and catalog.

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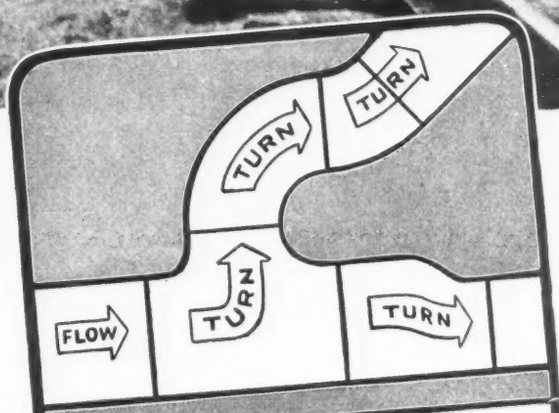
TUBE-TURN

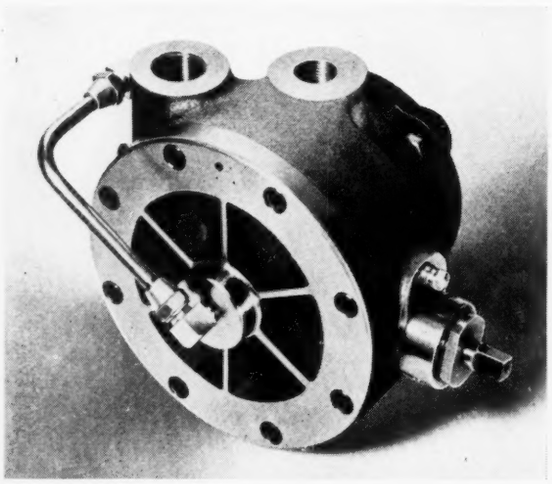
TRADE MARK

Welding ★ *The* ★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*



As indicated in the drawing above, there are vital "turns" in piping other than at elbows and returns. Tees, reducers, laterals, and nipples likewise entail abrupt changes in flow direction that result in *added* strain, friction and wear at these connections. The built-in strength of *all* Tube-Turn welding fittings gives unequalled reinforcement for *each* of these *danger spots*.

WHAT'S NEW IN PLANT EQUIPMENT



Vane-Type Pump

BALANCED, VANE-TYPE PUMP for oil-hydraulic operation and for working pressures up to 1250 lb announced. Available in range of from 0 to 8 gpm, it is recommended where operating conditions involve line surges. Each one of dual vanes is bevelled around its entire edge so that oil from the oil hole in the rotor can flow all around the edges. Increasing or decreasing rate of delivery is accomplished by means of an adjustment screw, and can be done while pump is operating. Delivery is infinitely variable over the range. *Detroit Universal Duplicator Co, Detroit, Mich.*

Regalvanizing Process

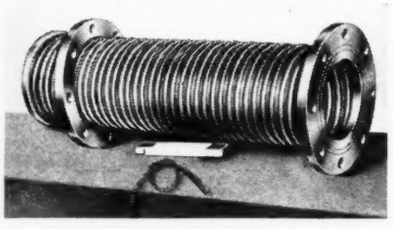
PROCESS PERMITS WELDING of galvanized or other sheets and structural metal parts, so that joints are left in rust-proof condition. In welded joints, regalvanizing is accomplished at time of welding, no redipping being necessary. Consists, in essentials, of rubbing bare spots, which have been heated by welding, with a stick of low-melting galvanizing material to form a smooth coating of metal that will have all of the corrosion-resisting properties, as well as wearing qualities of original galvanized coating. *Galv-Weld, Inc, Mutual Home Bldg, Dayton, Ohio.*

Heating Surface

EXTRA-LENGTH heating surface provided with steam-distributing tubes. Former hindrance to extra-length sections (means of insuring uniformity of distribution from which surface derives both its resistance to freezing and special control characteristics) is said to have been overcome. Problem of distribution was solved by combining two heating elements in single casing provided with separate steam nad return headers, yet so interconnected that only one main steam and return connection are necessary. *John J Nesbitt, Inc, Philadelphia, Pa.*

Metal Hose

SEAMLESS METAL HOSE has double-thread, helical corrugations. Unit shown represents anti-vibration tube of 6-in. ID; outside diameter measures 7¾ in., and overall length is 30 in. Rigid brass companion flange is brazed on one end; other end has floating flange for proper adjustment to existing equipment. Any length and any type end connection can be furnished. Company's smallest size hose shown in comparison. *Seamlex Co, Inc, 5-19 48th Ave, Long Island City, N.Y.*



Mobile Capacitor

PORTABLE UNIT WILL PROVIDE on-the-spot correction for reactive current at any point on distributing system; raise power factor at transformer banks and substations temporarily; and provide actual field checks on calculated capacitor installations at specific system locations. Unit weighs 13,200 lb, has 540-kva total capacity, obtained from three unequal banks of 15 kva Inerteen capacitors. Can be used on 2300-volt, 3-phase, 3-wire, or 4000-volt, 3-phase, 4-wire circuits with either manual or automatic control. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Hydraulic Vise

STUDEBAKER HYDRAULIC VISE designed to speed up small press and cutting operations can also be used for normal vise work in power-plant maintenance and repair shops. Unit is operated entirely by foot control, permitting use of both hands in setting up and removing work. Unit is self-sufficient, no outside power is needed. Pressure to control closed jaws is controlled by foot-pedal-pump arrangement in pedestal mounted on the floor. Latter is connected with vise proper by a steel tube which carries the hydraulic fluid to a

(*Continued on page* 148)

"They sure help our men keep piping on the job"

GOOD PIPING SERVICE BEGINS
UNSAFE!
SAFE!
WRONG!
RIGHT!
HOW TO KEEP YOUR PLANT GOING WITHOUT INTERRUPTION!
11 SIMPLE WAYS TO GET BETTER SERVICE FROM PIPING EQUIPMENT
HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE

CRANE SHOP BULLETINS

In these days, when Defense demands uninterrupted production—when plant equipment is overtaxed—when replacements aren't always quickly available, Crane offers you timely assistance.

Crane Shop Bulletins are aimed to help you get better service from piping equipment. They're designed for your maintenance workers—to help train new men—to improve the work of veterans.

To date, three Bulletins have been released. No. 1 gives hints on proper installation methods; No. 2 shows pointers on correct piping placement; No. 3 guides in valve selection and usage.

In the hands of your piping crews, or posted in maintenance shops is where these Bulletins will do you most good—if you already have them. If not, call your local Crane Representative, or write to us. They're free!

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

Get a Glory . . .

Archibald Rutledge tells this story: "On a day memorable to me, I boarded a tiny tugboat that I used often in crossing a southern river and saw that we had a new Negro engineer. He sat in the doorway of the engine room reading the Bible; he was fat, squat and black, but immaculate, and in his eyes was the splendor of ancient wisdom and peace with the world.

"As I paused to talk with him I noticed that the characteristic odors that had always emanated from the engine room were no longer there. And the engine! It gleamed and shone; from beneath its seat all the bilge-water was gone. Instead of grime and filth and stench I found beauty and order. When I asked the engineer how in the world he had managed to clean up the old room and the old engine, he answered in words that would go far toward solving life's main problems for many people.

" 'Cap'n,' he said, nodding fondly in the direction of the engine, 'It's just this way: I got a glory.' "

Making that engine the best on the river was that Negro engineer's glory—and having a glory, he had everything in life. His job—his mission—wasn't a very great one, but he did his best with it. He didn't waste useless time in being sorry for himself; he took his job, such as it was, and gave it every whipstitch of his strength.

It seems to me that in getting his "glory" he pointed out a worthwhile course for the rest of us.

George Edwards

Engineer

***You cannot prevent the birds of sorrow from flying over your head, but you can prevent them from building nests in your hair.*—Old Chinese proverb**

Uniformity, dependability, high quality... these are the features that make J-M Service Sheet the No. 1 Sheet Packing for industry

MORE AND MORE engineers are safeguarding gasket performance by switching to J-M Service Sheet. Basically asbestos, this tough material not only stands up longer, but is completely uniform, both in density and quality. Because it does not deteriorate with age, it can be kept in stock indefinitely.

If you're not already using J-M Service Sheet, it will pay you to investigate. And if you have any other packing problems, you'll find an efficient, economical solution in the balance of the complete J-M line. For details, write for the new J-M Packing Catalog, PK-12A. Johns-Manville, 22 East 40th Street, New York, N. Y.

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Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

. . . to Give *Unmatched* Performance

One of the big reasons that Dart Unions make up tight the first time, quickly and easily—stay tight longer—and can be re-installed so many times is due to the fact that they have matched bronze seats, ground to accurate "true-ball" surfaces. *Another* big reason for the complete satisfaction that Dart Unions give is that their bodies and nuts are made of air refined malleable iron that resists pipe strains, wrench abuse.

Now—when pressure on production is so high and you need equipment that you can install easily and *forget about*—specify DART UNIONS. If you wish—and will just tell us size and model—we will gladly send you a Dart to try free.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Pf Improvement

(*Continued from page 67*)

0.90 power-factor curve. From here drop vertically downward to the bottom of the chart. This shows that required capacitor capacity is equal to about 85% of the kilowatt load, or in this case 300x0.85 = 255 kva as obtained by the previous calculations.

Now for some examples of capacitors in industry: In a textile plant the management was confronted with the problem of reducing the load on an overloaded generator. This could be done by the purchase of a larger generator, purchase of power from the local utility, or doing something to reduce the load on the old generator, by improving the load power factor, which was about 0.62. A new generator would have cost less than $5000, and purchased power would have required an investment of at least $1500, besides power costs. It was therefore decided to invest approximately $2000 in a 75-kva capacitor, which increased the power factor to 0.90 and made it possible for the generator to carry the load with a safe margin.

Other Examples

Another larger plant had its power feeders overloaded because of increased production. The overload was removed by installing 1440 kva of capacitors to improve the power factor. These were divided into units and connected to the feeder system at 24 points where overloads occurred. The total cost of this installation was less than $13,000, but the reduction in power costs paid for the installation in a little over one year. In addition, feeder temperature was reduced and voltage improved.

A chair company installed a 300-kw, 0.80-power factor, 3-phase generator but it heated excessively when put into service. A check on the load showed that the generator was delivering approximately 300 kw at 0.60 power factor and to maintain voltage required 140 volts across its field coils. Installation of a 120-kva capacitor raised the power factor to 0.83, which brought the load and field excitation well within the generator rating.

A tool manufacturer purchased part of his power and generated part with a hydroelectric unit. To improve the power factor, an old 300-kw generator was operated as a synchronous condenser. A check-up on this method of operation showed that it was costing about $5.00 per day for power to

THE TAG TELLS THE STORY

1. ALL THREADS ARE INSIDE THE VALVE
2. THREADS ARE QUICK-ACTING—WON'T STICK
3. BALL-JOINT CONNECTION
4. CAN BE REPACKED UNDER FULL PRESSURE, IN SERVICE
5. FLEXIBLE STEAM CONNECTION
6. REPLACEABLE STAINLESS STEEL PARTS, SUPER-HARDENED

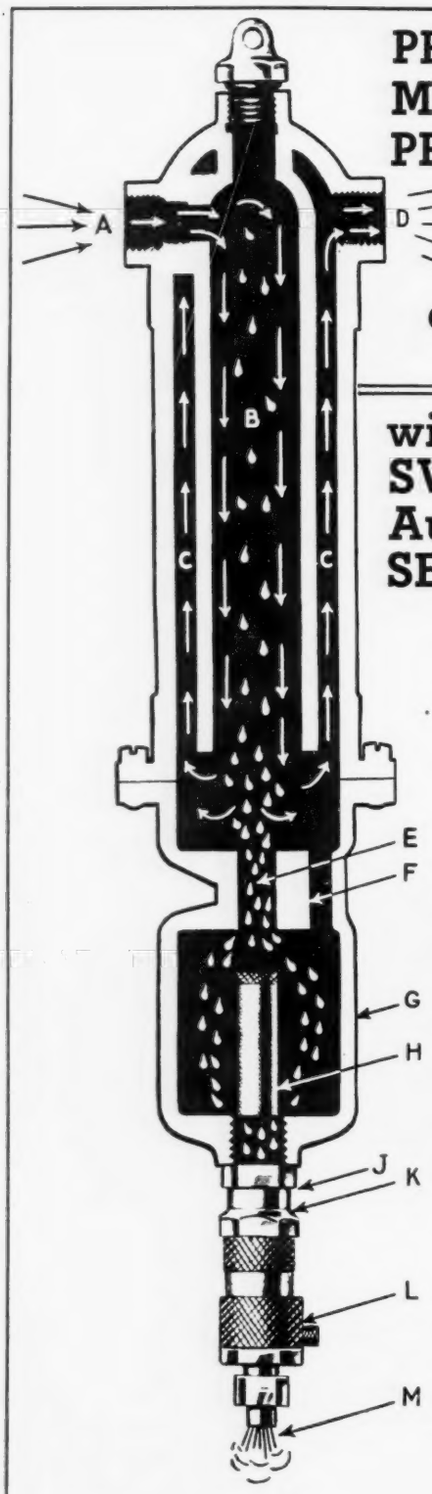
Chapman List 960

The big story in back of this small valve is one of better performance—performance that can be boiled down in terms of fewer troubles, repairs and operating kinks on all lines up to 2 inches. Give it a good stiff comparative test — under any pressure up to 800-lb. at 750° or 1500-lb. cold working pressure — and see for yourself the importance of standardizing your lines with Chapman List 960's.

THE CHAPMAN VALVE

MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.



PROTECT POWER MACHINES AND PROCESSES

from water— and oil-laden

compressed air

with SWENDEMAN Automatic SEPARATORS

If you're using compressed air *for any purpose* — now's the time to save power and maintain high machine efficiency and keep air lines at maximum air carrying capacity — with Swendeman Automatic Oil and Water Separators.

These simple, compact, dependable units, easily connected to your present air lines, will enable you to condition your compressed air free of moisture and oil—an important problem today in every plant running at full capacity when shut downs for repairs and replacements cannot be permitted. With "Swendemans" you can safeguard your production at almost negligible cost.

SIMPLE IN OPERATION

Air enters at "A", passes into expansion chamber "B", expands and precipitates all oil and moisture into eliminator "G" from which it is immediately expelled through vent "L". The air rises through expansion chamber "C", which, having a greater area than "B", gives the air a second chance to precipitate. Clean air returns to the line at "D".

A TYPE FOR EVERY NEED

Swendeman Separators are available in a wide range of sizes and in types for installations requiring and not requiring pressure regulation as well as constant or interrupted air supply. Our engineers will gladly help you meet your individual requirements.

Ask for FREE Bulletin giving details on sizes and types

THE LEAVITT MACHINE CO.

ORANGE, MASS.

operate the old generator as a synchronous condenser. A capacitor large enough to do a better job at power-factor improvement than the old generator would cost only a few cents a day for power and would require practically no maintenance. A capacitor was installed and the saving in power paid for its installation in less than two years.

Pickwick Landing

(*Continued from page* 100)

pressure above piston P_1 to move it downward. As piston P_1 moves downward, through lever L_1 it lifts the right-hand end of the floating lever and lowers its left-hand end around the flyball servomotor connection as a fulcrum. This action through lever L returns the regulating valve to the neutral position and stops the gate movement. From what has been shown of the governor action, the flyballs open the regulating valve to put the gates in motion, but as soon as the gates start to move they tend to bring the regulating valve to neutral to stop them. This action is necessary to obtain a stable governor that will not hunt. The reverse of the gate-closing operations take place to open the gate when load increases.

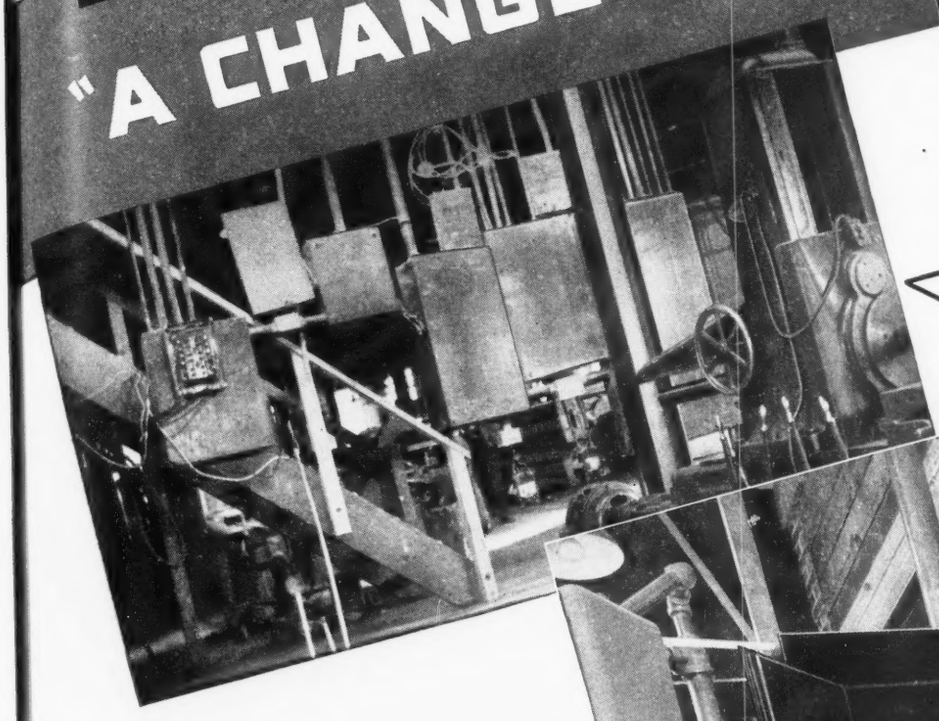
Piston P_1 attached to lever L_1 moves against the tension of restoring springs R which tend to restore it to midposition. Adjustable orifices permit oil to bypass from one side of the chamber to the other so that springs R will eventually bring piston P_1 back to its central position. Returning piston P_1 to midposition must be timed so that the speed response and guide-vane position change are proportional to load change to prevent the governor hunting.

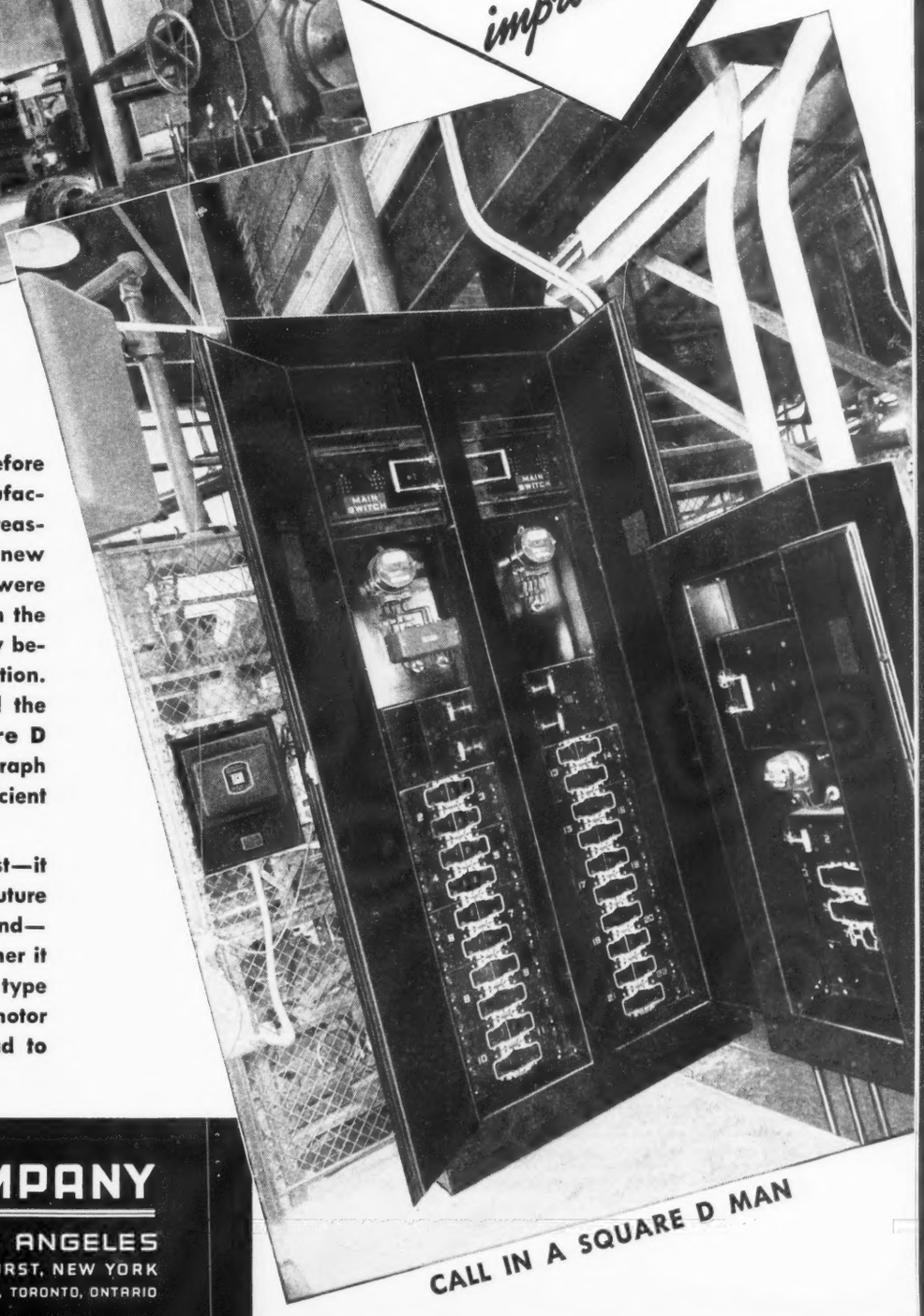
A synchronizer adjustment is connected to the center of lever L and is operated by a reversing motor controlled from the switchboard. One direction of motor rotation lifts the left-hand end of lever L and with it the regulating valve to apply oil pressure in the servomotors to open the guide vanes, and speed up the turbine. Reversing the synchronizing motor lowers the left-hand end of lever L and the regulating-valve piston to close the guide vanes and slow down the turbine. In addition to controlling turbine speed during synchronization with the power system, the synchronizer adjustment is used to load the unit after it is connected to the system.

D presents

"A CHANGE FOR THE BETTER"

Does your plant need this kind of improvement?





● The pictures tell an emphatic "before and after" story. A rapidly growing manufacturing company had not provided for increasing power and lighting requirements. As new circuits were needed, additional cabinets were added, one at a time. Eight are shown in the top photograph. Disorder and inefficiency became evident and the management took action. The old wiring was ripped out and all the circuits were grouped in the two **Square D Saflex panels** shown in the lower photograph —a safe, compact, convenient and efficient installation.

● This story has two morals. First—it costs substantially less to anticipate future needs *now*, than to replace later. Second—where replacement is necessary, the sooner it is done, the better. **Square D** has every type of equipment for current distribution and motor control. The **Square D Man** will be glad to consult and plan with you.

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

KOLLSMAN INSTRUMENT DIVISION, ELMHURST, NEW YORK

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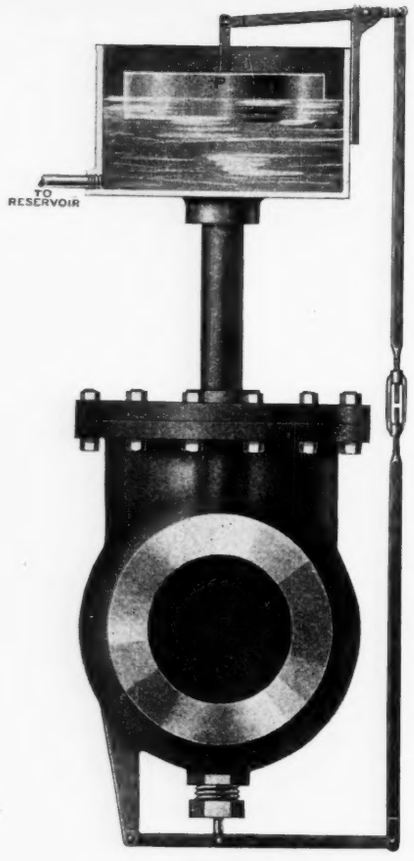
CALL IN A SQUARE D MAN

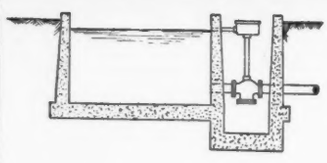
★

Golden-Anderson

SPECIALTY

VALVES





FLOAT CONTROL

● Especially practical and desirable for water level control in mixing chambers, coagulating basins, etc., is the G-A Balanced Controlling Float Valve. It *insures* a maximum water level and a constant rate of flow. In the closed position, this valve will seat absolutely tight, and it is cushioned to overcome any shock or surge. Provided in 3" to 24" sizes, this G-A all-around efficiency valve has flanged ends with iron body and bonnet and bronze trim. Complete and detailed information on the entire G-A line may be had upon request. Write for our latest free catalogs today.

also ***Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check Valves etc.***

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A load-limit device is also provided that limits the amount the guide vanes can be opened and consequently the amount of load that the unit will take. This consists of a bell-crank device B pivoted at C. One end of B can be made to rest on a collar on the regulating-valve actuator rod. The other end of B connects by a system of rods and levers to restoring sheave S_1. With the load-limit device in the position shown, the gates are at their opening limit because B rests upon the actuating-rod collar.

The amount of load that can be put onto the turbine is determined by the location of lever L_3 which can be positioned by a reversible motor, controlled from the switchboard. Moving the center connection of L_3 to the right will lift B to permit opening the gates farther. Moving the center connection of L_3 to the left would lower B and limit the gate position to a smaller opening.

Vane Position

As previously explained, the turbine runner-vanes are also adjusted by the governor to the most efficient position for any load on the unit. At no load, the runner vanes are turned to a practically flat position and at full load they are opened to an angle of about 30 deg with the horizontal. This is done by a rod R_1 connected between sheave S and cam C. Because of the rigid connections from the guide vanes and this cam, it has a fixed position for each opening of the guide vanes. A roller in one end of lever L_4 rests on cam C. A cable attached to the other end of lever L_4 connects through lever L_5 to floating lever L_6, which actuates the valve that controls pressure-oil flow to and from the runner-vane servomotor.

Turbine-gate movement toward the closed position turns sheave S clockwise and through rod R_1 turns cam C in the same direction. This permits the left-hand end of floating lever L_6 to move downward to open the ports of the regulating valve. Pressure oil can now flow into the top chamber on the turbine shaft and down through pipe T to below the servomotor piston. This piston, which connects by a heavy rod and crosshead to the runner blades, turns them toward the flat position. As the servomotor piston moves up it also lifts the right-hand end of floating lever L_6 to return the runner-vane regulating valve to the neutral position, thus stopping movement of the runner vanes at a position corresponding to guide-vane opening.

Relation of guide-vane opening and runner-vane position is different for different heads so there are provided 5

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WRITES ARKANSAS PLANT SUPERINTENDENT ABOUT FANMIX GAS BURNER

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A superintendent of a large Arkansas Plant writes about the FANMIX Gas Burner: "We have found that our production has been equivalent to, or a little better than, previous production with a saving of 5000 cu. ft. of gas per hour which is approximately 13.5%."

There are twelve exclusive advantages in the Coppus-Dennis Fanmix Gas Burner — which result not only in considerable savings, as reported in the testimonial above, but also in lower installation costs and also in higher ratings through perfect gas-air ratio and complete instantaneous combustion.

An entirely new method of driving the fan and simultaneously mixing gas and air in automatically controlled ratio, results in the greater simplicity and efficiency of this Burner. It will be well worth your while to study this new operating principle and its twelve benefits to you.

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On every Coppus product is a Blue Ribbon so that customers can easily see it is a product made under rigid controls of manufacture and inspection. See listing of other Coppus Products in this ad.

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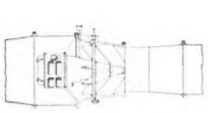

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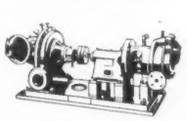

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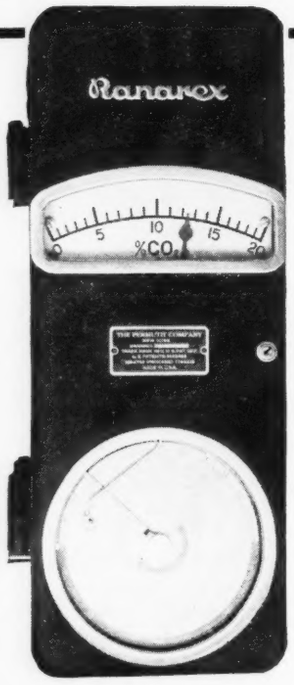

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cams *C* of different shapes. These are combined into one wide cam that is moved laterally so that the correct one for the prevailing head condition can be moved under the roller to position the runner vanes accordingly.

AISE Meeting Report

(*Continued from page* 128)

A committee of the AISE has been set up to work with a committee of the AIEE and with the electrical manufacturers in preparing standard specifications for circuit breakers. This move was made on the part of the AISE so that such standards would meet the requirement of the steel industry. The committee has held several meetings, and it is expected that definite recommendations regarding ratings, etc. can be drawn up and submitted to the American Standards Committee. It is further expected that the work will apply insofar as possible to oil circuit breakers, as well as the oil-less breaker, and that it may be extended to include 25 as well as 60-cycle service.

Committee Report

A report of the progress of the AISE Crane Specification Committee was delivered by E W Cramer, chairman of the committee. This committee has been working for the past three years on a revision of standard crane specifications. Representatives of the various crane manufacturers have also participated in the work. Perhaps the most important item of this revision is the question of crane-girder design, and the committee has completed a comprehensive research project on this subject. This project was carried on by I E Madsen, and included large-scale laboratory tests of box girders, as well as shop and field tests on cranes. Mr Madsen's report, which will form a basis of the crane bridge-girder specifications, have been completed.

Other papers of interest to power engineers included "Recent Advances in Control of Multi-Fuel Fired Furnaces," by J C Vaaler, Askania Regulator Co, Chicago, Ill.; "Report on Field Tests on IR Drop Compensation," by G E Stoltz, Westinghouse Elec & Mfg Co, East Pittsburgh, Pa.; "Application of Power to Temper Mills," by T B Montgomery, Allis-Chalmers Mfg Co, Milwaukee, Wis.; "Motor Applications for Strip Processing Lines", by H W Poole, General Electric Co, Schenectady, N. Y.; "Diesel Engine Lubrication," by D

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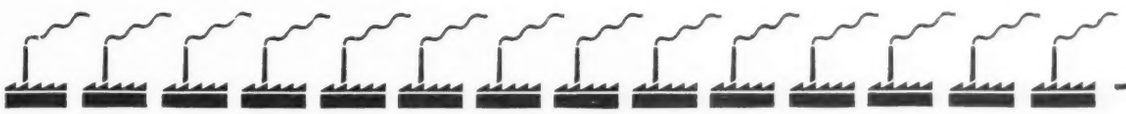

FROM the many divisions of ELECTRIC AUTO-LITE, world's largest independent makers of automotive parts and appliances, pour out over 400 different products . . . standard equipment for nearly a hundred different makes of automobiles and trucks. A major objective of all these manufacturing operations is to be "constantly cutting costs without sacrificing quality." One proved economy, standard in Electric Auto-Lite plants, is the use of modern, prepared COAL. On a basis of fuel costs, high efficiency and low maintenance and steam costs, "For our purposes," says the engineer in charge, Mr. W. E. Whalen, *"we find COAL the most economical of fuels."*

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To help industrialists lower the cost of producing power and heat, Chesapeake and Ohio Lines maintains a staff of Fuel Service Engineers. These trained and experienced men act in advisory capacity . . . surveying power plants, consulting with plant engineers, suggesting ways to increase efficiencies. Their services are offered without charge or obligation. Would you like to have an economy study made in *your* plant? You have only to request it. Write to GEORGE H. REINBRECHT, Coal Traffic Mgr., Chesapeake and Ohio Lines, 2901 Terminal Tower, Cleveland, O.

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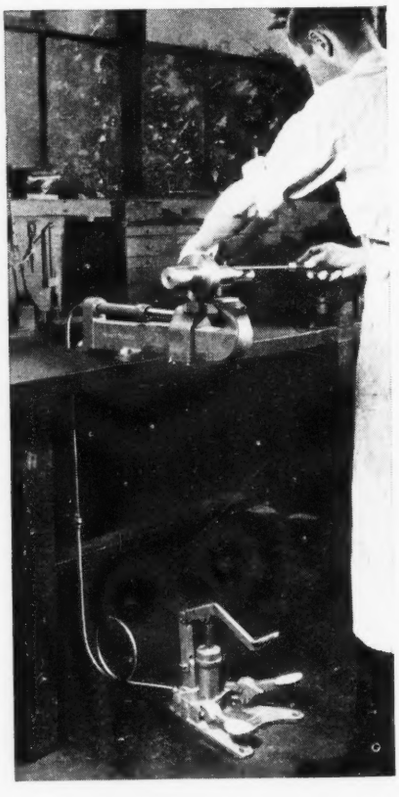
N Evans, Inland Steel Co, East Chicago, Ind.; "Sealing Methods of Oil-Film Bearings," by L F Coffin, Bethlehem Steel Co, Sparrows Point, Md.; and "Filtration and Reclamation of Oils," by C A Bailey, Carnegie-Illinois Steel Corp, Gary, Ind.

New officers elected are: Thomas E Hughes, superintendent of maintenance, Carnegie-Illinois Steel Corp, Duquesne, Pa., president; Frank E Flynn, district manager, Republic Steel Corp, Warren, O., 1st vice president; C L McGranahan, assistant general superintendent, Jones & Laughlin Steel Corp, Pittsburgh, Pa., 2nd vice president; J. L Miller, assistant chief combustion engineer, Republic Steel Corp, Cleveland, O., secretary.

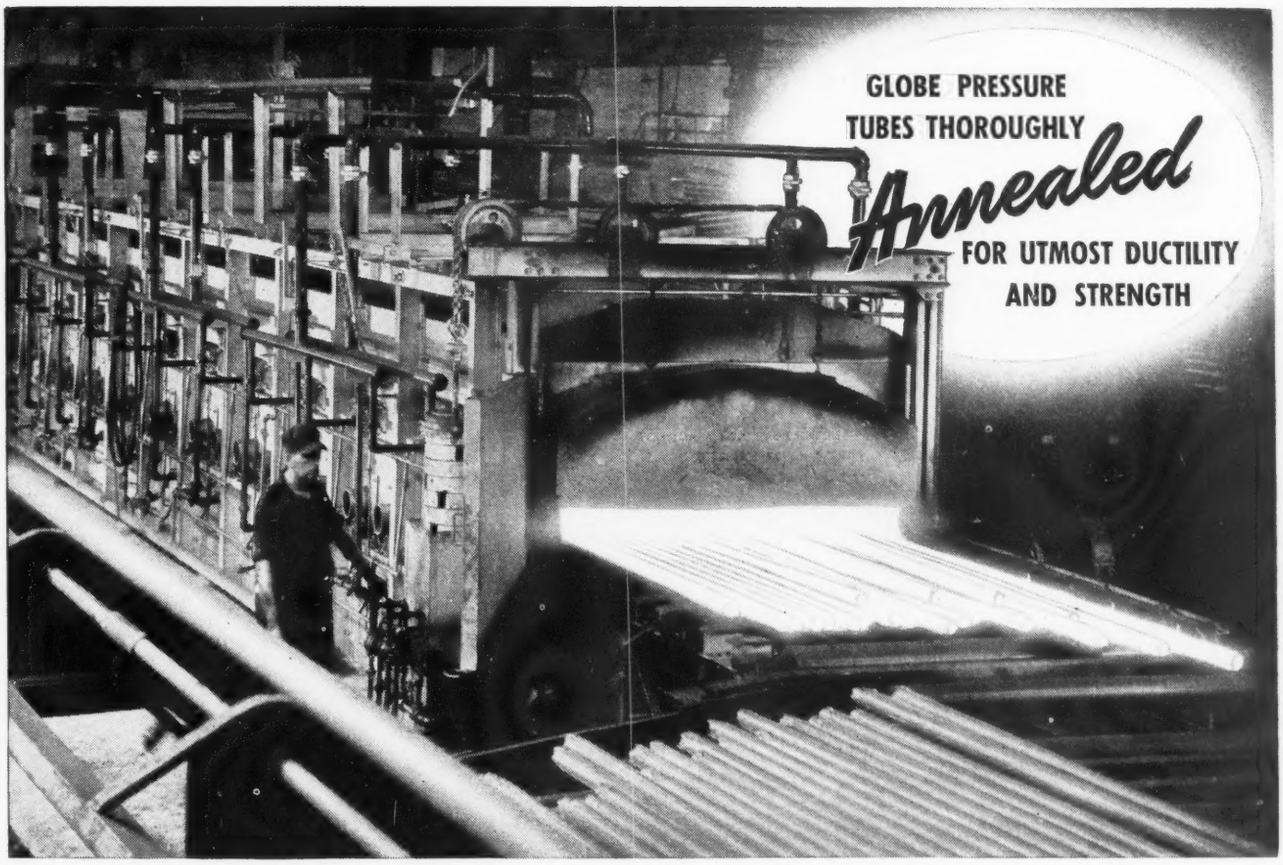
New Plant Equipment

(*Continued from page* 136)

ram behind the back jaw. Front jaw is stationary. Stepping on one pedal moves the vise jaw to contact against



the work. Second pedal applies pressure up to five tons, and third pedal removes pressure and releases the jaw. Illustration above shows vise arrangement, with pipes, pedals, etc, as attached to ordinary workbench.—*Studebaker Machine Co, Chicago, Ill.*



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Before you specify boiler tubing — check with a Globe engineer—to assist you in selecting a tube with the exacts characteristics for your specific needs.

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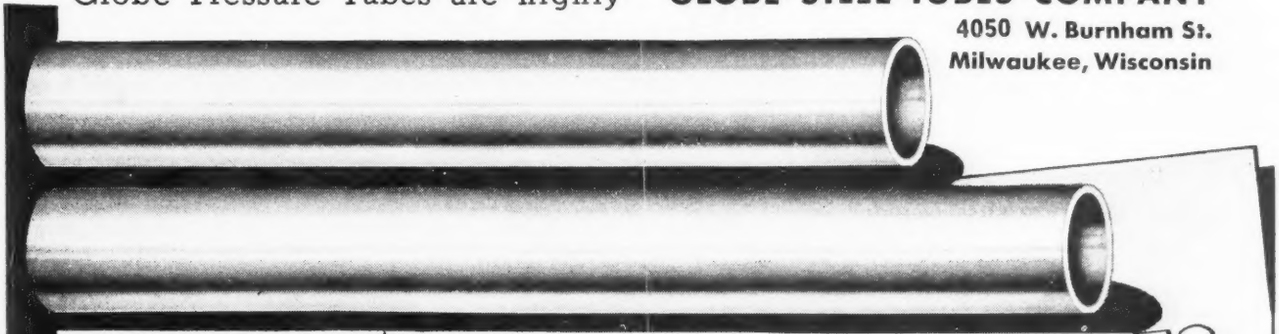

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are you throwing away DOLLARS IN DUST?

FOUNDRY SHAKE-OUTS

Buell Collectors are widely used to collect dust in shake-out rooms, to prevent dust escaping from tumbling barrels, and to reclaim dust from the cleaning of molding sand.

MACHINING OPERATIONS

In machining operations such as grinding, buffing, milling, planing, etc., Buell Dust Collectors, applied to exhaust hood systems, have an outstanding record of high efficiency.

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Contamination of product in dryers utilizing dust laden waste heat gases is eliminated by the use of Buell cyclones, which have been found to have higher efficiency and lower power consumption than collectors which they replaced.

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Buell has developed collectors of special design and notable efficiency for many food products, such as powdered coffee, powdered milk, etc. Fabrication of stainless steel and hinged construction for easy cleaning meet all pure food law requirements.

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Buell Dust Collectors have proved highly efficient in removing contaminating flue dust from gases (such as sulphur dioxide in sulphuric acid manufacture), and in salvaging valuable dust (as in spray drying of magnesium hydrate) normally lost in exhaust.

OTHER APPLICATIONS

Alkalis
Carbon Products
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and many others

THESE ARE JUST A FEW of the many applications in which Buell (van Tongeren) Dust Collectors are successfully serving such leaders of industry as Detroit Edison Co., Dow Chemical Company, Ford Motor Company, Lone Star Cement Corp., Nestle's Milk Products, Inc., and many others. The Buell Dust Technician in your territory will be glad to discuss the application of Buell (van Tongeren) Dust Collectors to your business.

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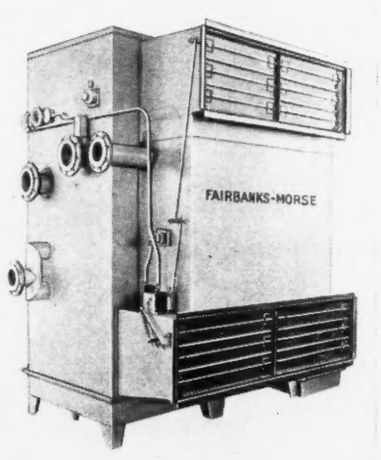
Evaporative Coolers

DIESEL ENGINE JACKET-WATER coolers consist essentially of coil through which jacket water passes, nozzles to spray water on the coil and a blower to force air past the coils. In operation, hot jacket water enters cooling coil at top of cooler, water from reservoir at bottom of unit sprays over coil from



one end and air blows in from the other. Jacket-water heat is absorbed by air through direct transfer and by evaporation of water on coil surface. After being cooled, jacket water then returns to engine. Spray water is constantly recirculated so that active amount consumed is only about 2 lb per 1000 Btu of engine heat absorbed. *Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.*

Starter Switch

"NO-BLINK" STARTER SWITCH is designed specifically for 40-watt Mazda fluorescent lamp, and will eliminate blinking and flickering of burned-out tubes. Accomplishes this by ending fluorescent lamp's life when it has reached the stage where it blinks on and off. Starter switches will last longer because they will not be impaired by repeated attempts to start the lamp. New switches are to be interchangeable with present FS-4 2-contact switches. They will be available in limited quantities for the present, with defense industries getting preference. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Starters

GENERAL-PURPOSE STARTER designed for protection against short circuits and overloads. Consists of oil-immersed contactor with self-cleaning

AN EXTRA FACTOR OF SAFETY *with Every Tube!*

With every Republic ELECTRUNITE Tube installed in boiler service goes an extra factor of safety — protection against heavy loading — insurance against premature tube failure.

To prove that it is ready for use, every tube must withstand, while under vibration, a hydrostatic pressure within 20% of the minimum yield point of the steel. Thus, every ELECTRUNITE Tube you receive has successfully passed a rigid pressure test as much as 400% or more above the accepted 1000-pound A.S.M.E. code requirement.

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You'll find many other life-extending and cost-saving features of interest in the full story of these time-tested tubes. Write for it. Steel and Tubes Division, Republic Steel Corporation, Cleveland, Ohio.

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For instance, look at the ground radial seat between body and bonnet. This assures perfect alignment of parts when valve is taken apart for replacement of disc and guarantees a tight body joint after every assembly. It also eliminates sliding and scraping of the surface of seat, therefore increases the life of valve.

The slide-on disc holder makes it easy to change disc while valve is on the line. Guides on disc holder prevent binding or sticking regardless of position of valve.

Protected top seat, **above** stem threads, seats tightly on bonnet when valve is opened for repacking under pressure and eliminates pitting and scoring. No sediment can reach this point to prevent tight closing.

Heavy rolled-bronze stem has an average strength of 65,000 lbs. per sq. in. More than five Acme threads are always in contact with bonnet, insuring easy operation and reducing wear on stem.

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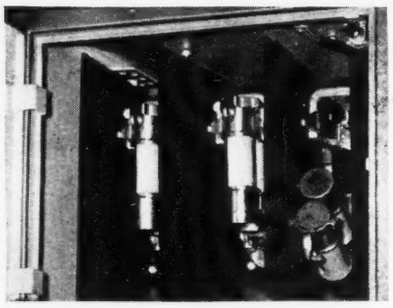
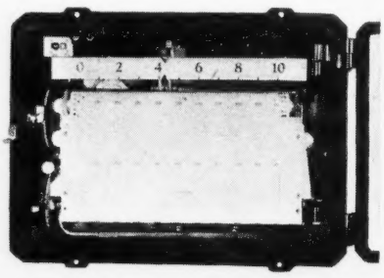


copper tips, wide metal bearings and copper-braided shunts, with current-limiting fuses for short-circuit protection. Four standard types of starters available, providing for full-voltage starting, reduced-voltage starting, and reversing of squirrel-cage and synchronous motors. *General Electric Co, Schenectady, N. Y.*

Proportional Controller

CELECTRAY PROPORTIONAL CONTROLLER fits applications in which throttling control with or without automatic reset is required. Throttling control is accomplished by this instrument through a simple method. When temperature is far below control point, as in starting up, the valve will be wide open; as



the temperature rises and enters the throttling zone, the valve will close a relay. This action prevents overshooting as temperature reaches a balance between heat input and heat loss. Other types with adjustment for manual reset (load error) or automatic reset are available. Throttling zone can be adjusted between wide limits, according to lag characteristics of the application. *C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.*

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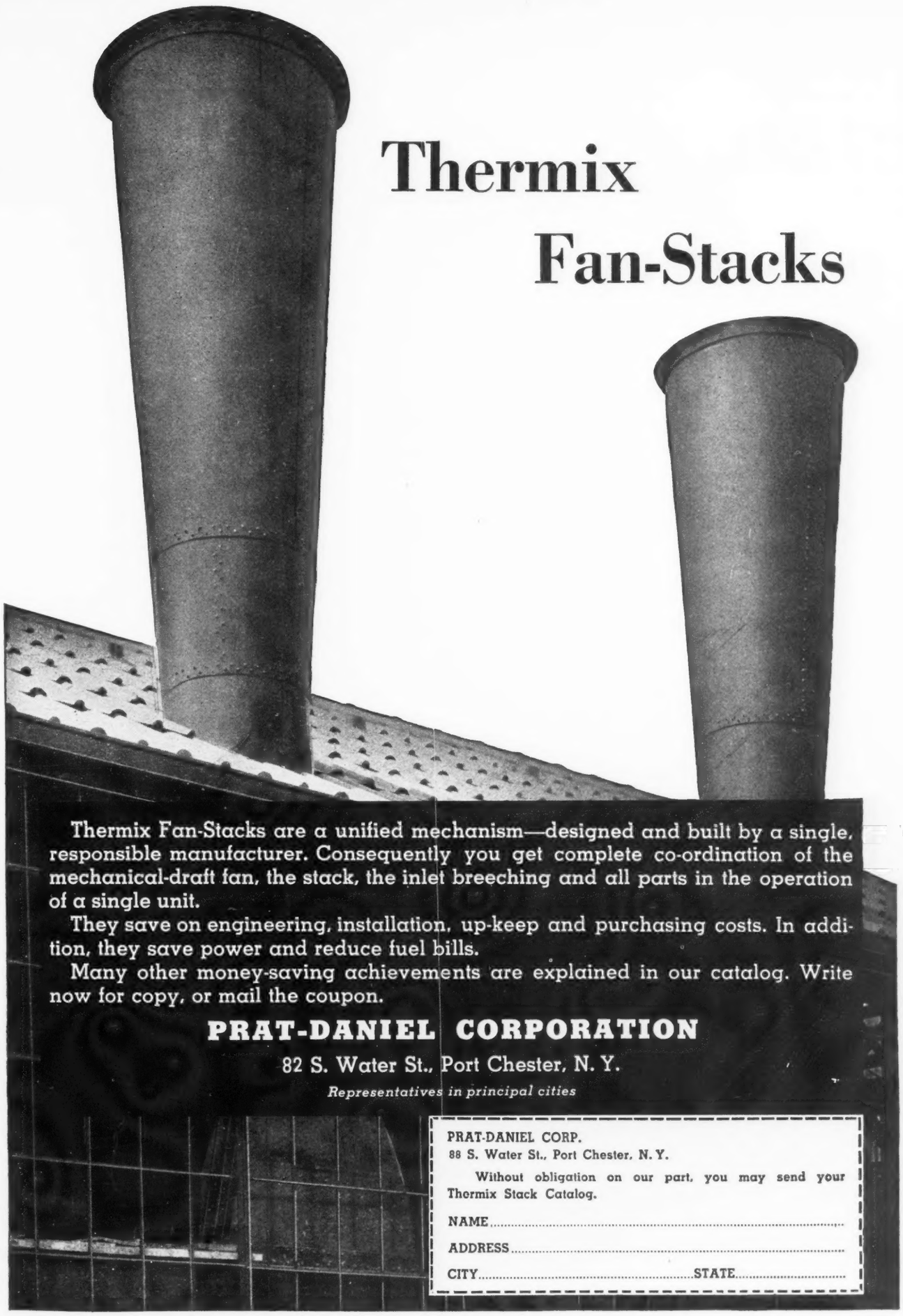
PORTABLE WELDING MACHINES with built-in transformer, entire unit designed for suspension from monorails, in effect, machines are a cross between pedestal and gun welders. Like welding guns, they may be moved or swung



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Thermix Fan-Stacks are a unified mechanism—designed and built by a single, responsible manufacturer. Consequently you get complete co-ordination of the mechanical-draft fan, the stack, the inlet breeching and all parts in the operation of a single unit.

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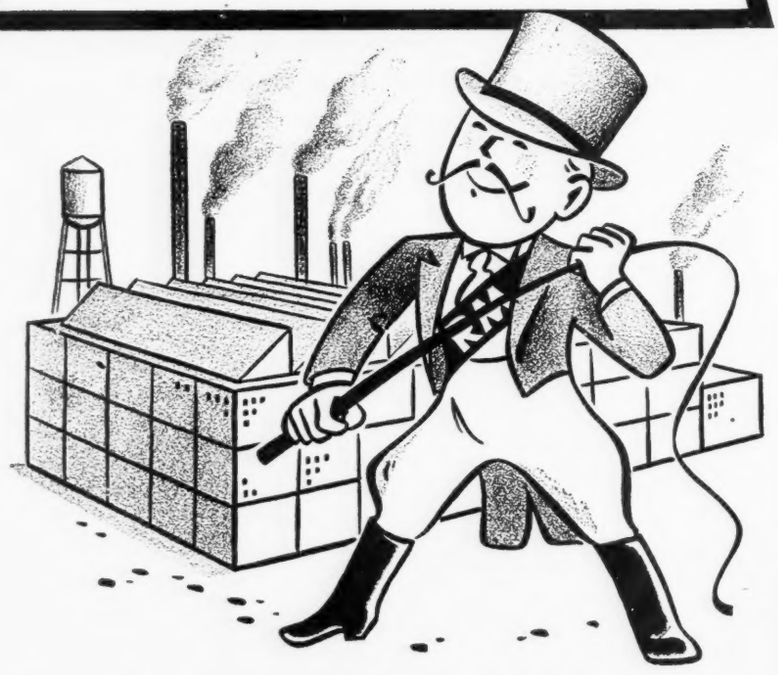

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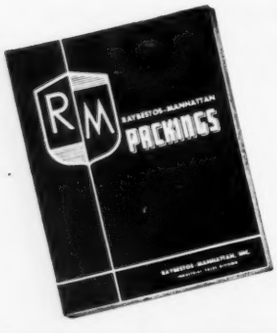

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around to bring the gun to the work, and like pedestal welders, they have rigid adjustable arms. By sliding arms in or out of the support housing below the transformer, they can be adjusted, if desired, to a definite electrode distance from the supporter housing to simplify locating tips for specific welds. Electrode tips are water cooled, with water connections brought along welding arm to support housing, connecting to same supply line used for transformer cooling. Transformers are provided with heat-control selectors. *Progressive Welder Co, Detroit Mich.*

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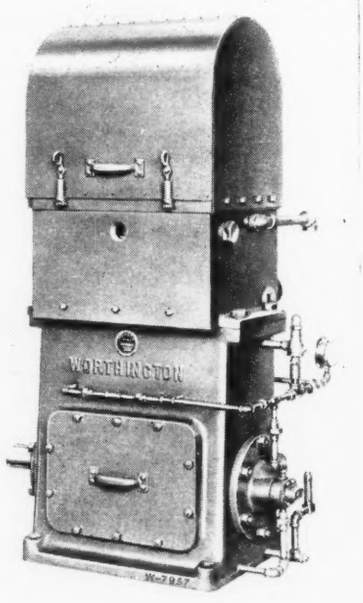
VERTICAL TRIPLEX single-acting plunger-type pump suits small-capacity, high-pressure applications. Pump has



no gears and is specially designed for use with built-in gear-head motors, although it can be used for V-belt drives. Construction features outboard plungers, with dry joint between liquid cylinder and power frame. *Worthington Pump & Machinery Corp, Harrison, N. J.*

Condenser

STRAUB DEGASSING CONDENSER removes carbon dioxide, oxygen, ammonia and hydrogen from samples of steam or condensate. In operation, unit boils degassed condensate, to furnish a gas-free steam which in turn degasses the continuously supplied untreated condensate. Gases are removed in scrubbing tower or stripping column, which

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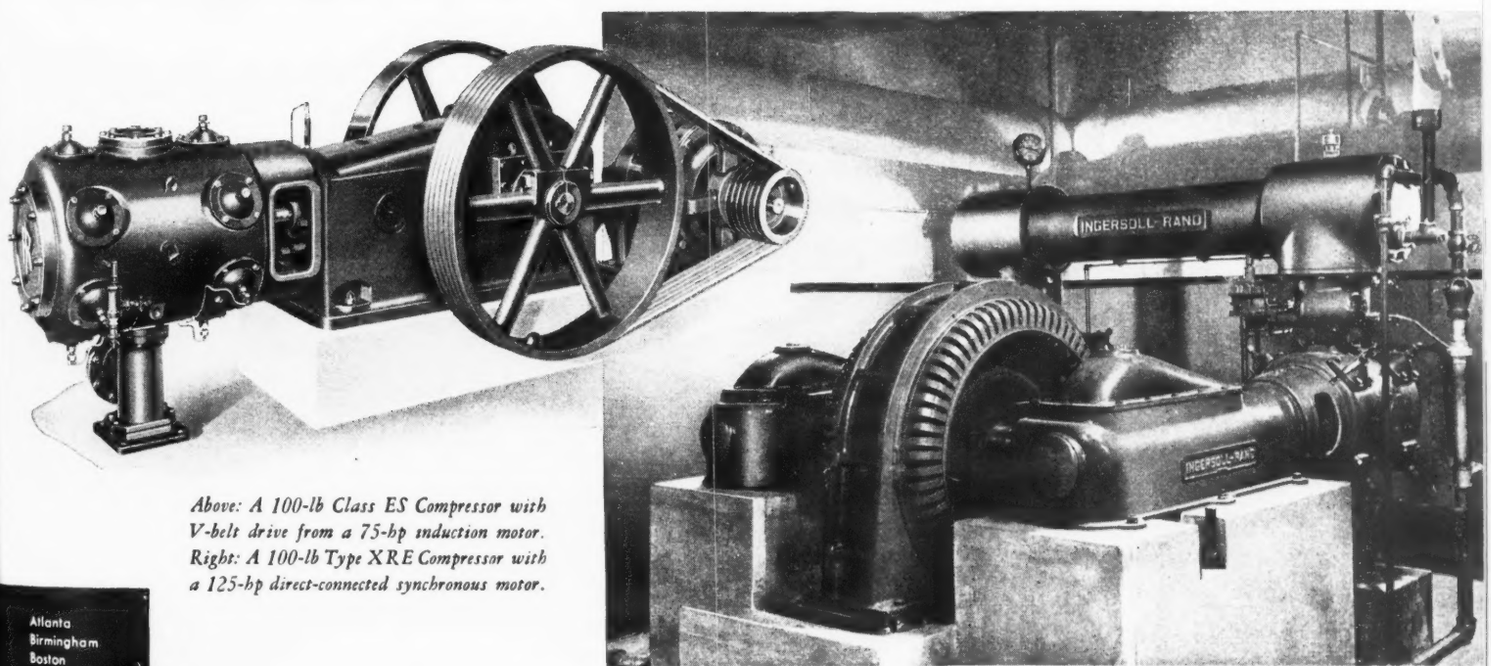
As more and more industries add new equipment and work around the clock — more and more power will be needed. Power waste is serious in the present emergency.

Ingersoll-Rand Electric-Motor-Driven Compressors are doing their part



Above: A 100-lb Class ES Compressor with V-belt drive from a 75-hp induction motor. Right: A 100-lb Type XRE Compressor with a 125-hp direct-connected synchronous motor.

The many thousands of electric-motor-driven air and gas compressors operating today consume a lot of power.

A medium-size 100-lb industrial compressor of about 1200-cfm capacity will consume more than 1,500,000 kilowatt hours in a year of continuous full-load operation.

A compressor 5% less efficient than a modern Ingersoll-Rand unit of this size, will use nearly 80,000 additional kilowatt hours a year — a needless waste of power in a time of emergency. The many thousands of efficient I-R compressors in use are making an important contribution by eliminating unnecessary waste of power.

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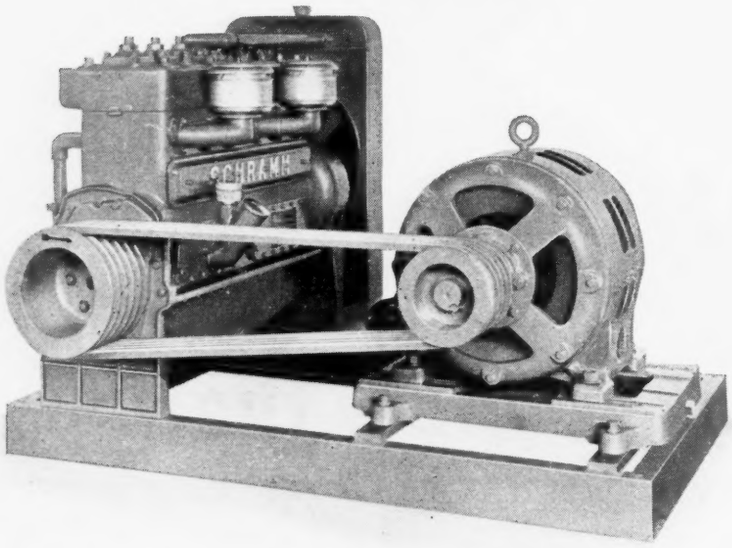
1-82

SCHRAMM

AIR COMPRESSORS

EASY TO INSTALL



Schramm Compressor with "V" Belt Drive, 75 H.P. Motor
480 cu. ft. Air Displacement, Complete with Cooling Unit.

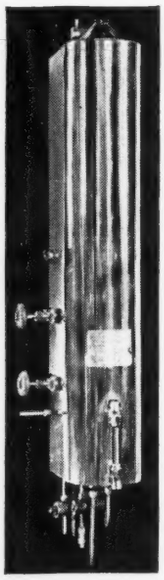
- SCHRAMM Stationary Compressors; are modern in design with light-weight reciprocating parts and thorough lubrication.
- SAVES POWER COSTS; by use of correct size unit for each service. Each motor correctly loaded and operates only when needed. Light friction loads with force-feed lubrication reduce wear to a minimum.
- AUTOMATIC CONTROL; with only one moving part permits setting unloading pressure at any point, completely controls the compressing action of the compressor, is simple, positive and cannot wear or jam.
- MECHANICAL INTAKE VALVES; operating from a camshaft, in perfect timing with crankshaft and piston travel. Cylinders are filled with air at exact moment for greatest efficiency. Long-life discharge valves with four times greater valve area and a 50% less valve lift.
- PERFECT BALANCE of multiple cylinder construction eliminates vibration—compact—ready to bolt to any solid, level floor.

Sizes 20 to 600 cu. ft. displacement

Write for engineering Catalog No. 3907

SCHRAMM, INC., WEST CHESTER, PA.

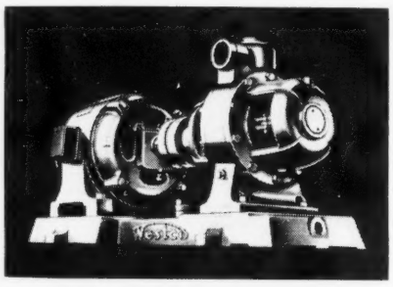
SCHRAMM UTILITY STATIONARY AIR COMPRESSORS



is surmounted by a vent condenser and gas vent at top of unit. Gas-free sample flows out of unit for determination of dissolved solids by conductivity method. *W H & L D Betz, Gillingham and Worth Sts, Frankford, Philadelphia, Pa.*

Turbine Pumps

WESTCO TURBINE PUMPS announced in new series featuring renewable liner. This liner minimizes shut-down losses and production delays, for the liners, forming the liquid channel within the unit, can be replaced. Also guards against premature obsolescence by permitting pump capacity and range to



be altered, within reasonable limits, in the field. This alteration is accomplished without disturbing the suction or discharge lines, simply by replacing the liners with a different set and slipping a new, matching impeller in position. Illustration shows exterior view of pump. *Micro-Westco Inc, Bettendorf, Iowa.*

Feeder Control

MOSHER CONTROL regulates mechanical feeding of pulverizing machinery. Utilizes simple electronic device. Con-

Perhaps we can't see the forest for the trees

Today industry generally is so absorbed with its manufacturing problems that it may not at the moment see the problems of others. We are well aware that we may be overlooking some new opportunity for asbestos to serve industry.

Because we hold it our first duty to meet the known needs of national defense, our production today is busy with things on order. We believe that not a customer would have it otherwise, despite the inconvenience it may cause him.

But, we can *think* of the future. In fact, our research men are continuing to prepare for the future . . . to the end that the return of normal times will bring you fuller service from asbestos.

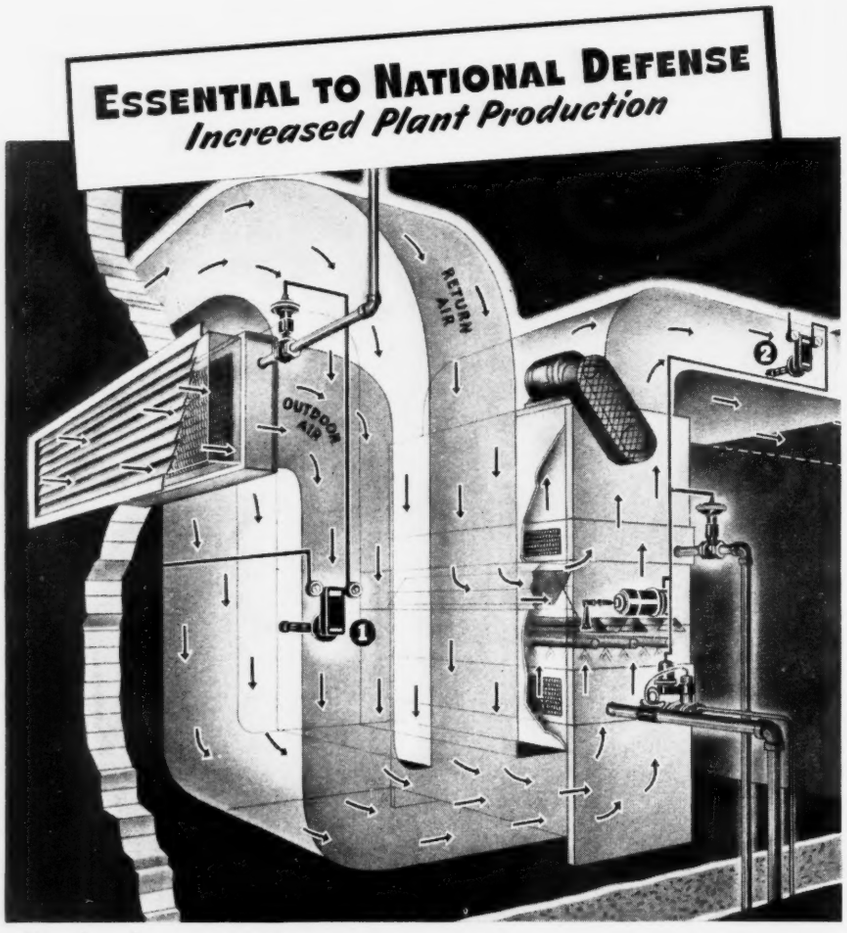
In this you can help us. Have you a problem that might be solved by the application of asbestos? We will give thorough consideration to any suggestion, in the hope that it will prove to be practical from a manufacturing standpoint. We'd appreciate a letter from you.

* * *

Nature made asbestos; Keasbey & Mattison has made it serve mankind . . . since 1873.

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

K&M best in asbestos



Enlist JOHNSON "Proper Sequence" CONTROL

FOR SPACE CONDITIONING

THERE must be no bogging down in the rate of production by American industries. "SPEED UP" is the slogan of today. Only when temperatures and humidities are maintained at proper levels can certain manufacturing operations be carried on successfully, without "shut-down losses." Special areas, such as test chambers, calibrating rooms for measuring instruments, curing rooms, and storage spaces, in many instances, must be provided with controlled conditions. Processing machinery, too, dipping tanks, kilns, vats, dryers and coolers, require accurate control of temperatures . . . The nation-wide Johnson organization has been built especially to furnish and install automatic temperature control for just such purposes. The entire problem is solved by Johnson men, from preliminary engineering recommendations down through manufacturing and installing the equipment. There is no division of responsibility, no delay! Ask for a Johnson engineer, from a nearby branch office, or send for descriptive bulletins relating to your problems. No obligation, of course.

JOHNSON *Jeweled Movement* THERMOSTATS

The illustration above indicates "Proper Sequence" control, by Johnson *Jeweled Movement* thermostats, applied to a typical year-'round industrial air conditioning unit. Thermostat "1", in the outdoor intake, set at 40°, controls the valve on the steam supply to the tempering heater . . . Thermostat "2", in outlet from conditioner, produces the following sequence of operations, when the temperature tends to rise: (1) Gradually closes the valve on the steam supply to the heating coil. (2) Gradually opens the modulating valve on the liquid refrigerant line which supplies the cooling coil. (3) Gradually opens the damper over the cooling coil and closes the bypass which leads from return air. On falling temperature, the reverse cycle of operations takes place...Room thermostats "3", in the conditioned space (not shown in the illustration), each control a valve on the booster heater for each area . . .; Johnson Control for "Proper Sequence" operation, always.

JOHNSON

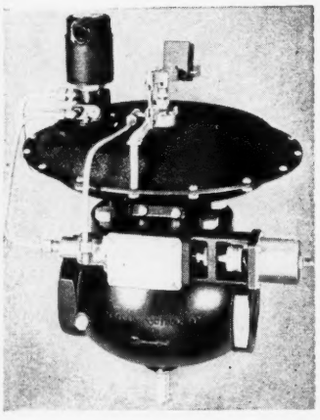
Automatic TEMPERATURE AND AIR CONDITIONING *Control*

JOHNSON SERVICE COMPANY, MILWAUKEE, WIS., AND DIRECT BRANCHES IN PRINCIPAL CITIES

sists of control unit mounted in steel case, which connects to magnetic contactor switch of motor operating mechanical feeder. Control panels are built in capacities up to about 250 hp on grinder motor and for about 5 hp on feeder motor. Standard voltages range up to 550 volts, but equipment can be built for voltages up to 2300 on main grinding motors. Control proper operates from 110-volt 60-cycle line. *Industrial Instruments, Inc. 156 Culver Ave, Jersey City N. J.*

Combustion Control

COMBUSTION CONTROL has integral governor which regulates fuel supply to burner in direct relation to steam pressure. Diaphragm-operated fuel-supply valve is electrically piloted and acts to maintain a constant steam pressure at all times by throttling gas flow and air damper in direct proportion, yet eliminates "hunting aspect" common to most throttling valves. Valve has low-fire adjustment which sets minimum amount of fuel supplied to burner. *General Controls Co, Glendale, Calif.*



Emergency Light and Power Units

EXIDE SYSTEMS, used in connection with battery of either "Chloride" or "Flat-Plate" type, have automatic transfer switch which shifts battery to emergency lighting circuit upon failure of normal ac supply. When ac service is restored, emergency lighting circuits are instantly transferred back to the ac supply. Battery is kept fully charged at all times, because immediately after normal power is restored, battery is placed on high-rate charge. As soon as recharging is completed, high rate is cut off and copper-oxide rectifier supplies a low-

RECORD breaking
IS A John CRANE custom
Case Record . . .
3 YEARS OF VALVE STEM HEAVY DUTY
WITHOUT GLAND ADJUSTMENTS! . . .
Industrial Service; Pressure: 660 lbs. Temperature: 750°F.
REASON?
PLUS-PAK...
That Patented, Exclusive Xxtra Which Lasts Twice As Long!

John CRANE Style 6AM Super-heat STEAM PACKING

. . . . Crane packing records are so successive, as to appear as everyday performance . . . John Crane has become known as the select packing, because of the winning qualities inherent in pre-tested ingredients, expertly assembled and tailored to exacting needs, and because of PLUS-PAK—that exclusive refinement which is a plus-value of Crane.

RECOMMENDED FOR:

pressures up to 1200 pounds and temperatures up to 900° F. Die-formed rings and sets available.

CRANE PROBLEM COUNSEL . . .

is offered without obligation on any packing condition. Consult with our engineering staff on Special Packings.

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CRANE PACKING COMPANY, Limited, Hamilton, Ontario, Canada

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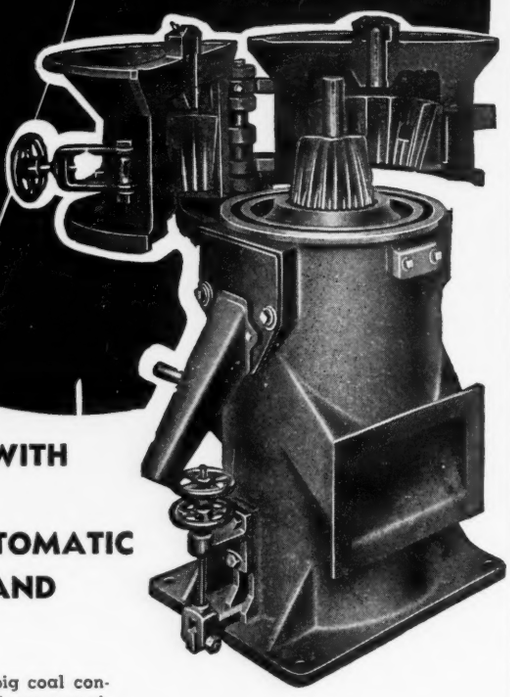
RUNNING 24 HOURS?
BURNING MORE COAL?

. . . Then get your money's worth of B.T.U.'s



. . . BY ANALYZING WITH THE IMPROVED STURTEVANT AUTOMATIC COAL CRUSHER AND SAMPLER . . .

Now's the time to do what most big coal consumers do—*sample your coal* to insure maximum performance and economy.

The "Sturtevant Way" provides a simple method of preparing samples for analysis, saves hand labor, avoids delays and prevents inaccuracies.

The Sturtevant Machine crushes 3" and smaller coal and coke at the rate of 1 ton per hour to 8 mesh and finer, and automatically picks out truly representative 5, 10 or 15% samples of all coal or coke passing. This method actually eliminates 32 of the 34 slow, inaccurate steps involved in hand sampling. Massive construction, simplicity and slow speed insure long life and low maintenance. Only 3 HP required to operate.

Write today for Bulletin 85—sent FREE on request.

WHAT A FEW USERS SAY . . .

. . . "the personal equation has been entirely eliminated"

. . . "savings average $6000- over non-sampling in 100,-000 tons"

. . . "has paid for itself through elimination of evaporation of moisture during preparation"

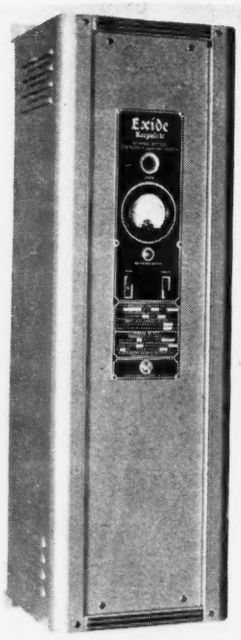
. . . "gives us more representative sample"

FOR SAVINGS . . .

"SAMPLE YOUR COAL BEFORE YOU BURN IT"

Sturtevant Mill Co.

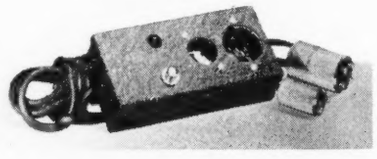
103 Clayton St., Dorchester, Boston, Mass.



rate charge, just enough to maintain battery in a fully charged condition ready for next emergency. *Electric Storage Battery Co, Philadelphia, Pa.*

Fluorescent Tester

MITCHELL TESTER enables user to test fixtures, bulbs, starters and ballasts to determine cause of failure. Tester is simple to operate and tells immediately which of several component parts need replacement. Has two starter adapters that enable testing of lamps from 15 to 100 watts, as well as starters and ballasts for different wattage lamps. *Mitchell Mfg Co, 2525 Clybourn Ave, Chicago, Ill.*



Waterproofing Compound

PRIMOID STANDARD is one of four compounds, said to be effective seals for concrete, brick, stone and other types of masonry, as well as for wood and composition materials. It is clear rubber-base liquid which can be either sprayed or brushed on, and will not crack, peal off, or be affected by heat and cold. Also said to be adaptable for use as a coating for iron, steel and other metals, preventing corrosion, and resisting oils, brine, acids and other chemicals. *Primoid Products Corp, 103 Park Ave, New York, N. Y.*

IRON FIREMAN CUTS COSTS

$1885 YEARLY

for Denver Laundry Plant

BEN K. LANTZ

Fuel Costs Reduced 29%

and one man's time saved . . . these are the accomplishments of an Iron Fireman Pneumatic Spreader stoker in the Lantz Sanitary Laundry Co., Denver. The saving is $1885 yearly.

Reports Ben K. Lantz, president: "While your Pneumatic Spreader stoker replaced another stoker of the over-fire feeding type, which we considered fairly efficient, our new installation is more than meeting our expectations."

Uniform Pressure for Engine

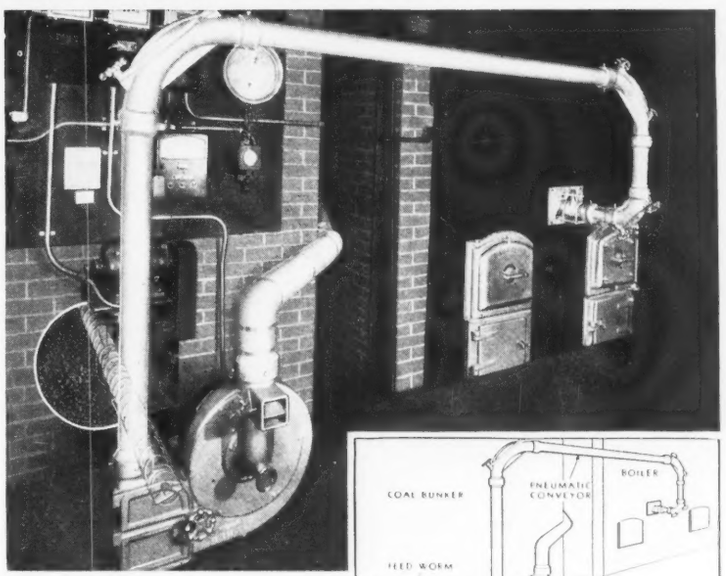
The Lantz Iron Fireman Pneumatic Spreader stoker maintains steady steam pressure, improves production in the whole laundry. Machinery operates more smoothly, efficiently.

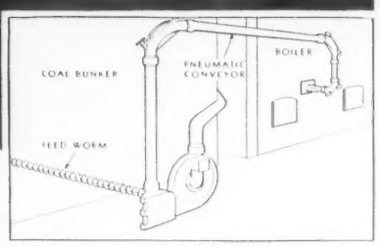
Clean Stack

Added to the other benefits is a clean stack. The Iron Fireman Pneumatic Spreader stoker burns coal more completely, minimizes smoke, cuts down ash and coal handling.

Burning Lignite

This Iron Fireman performance record was made with a lignite costing 50 cents a ton less than the coal formerly used. The Pneumatic Spreader stoker feeds lignite from a bunker at one side of the boiler to the firebox, leaving the front of the boiler free for easy access.





Only the Pneumatic Spreader Type of Stoker Can Give You This Flexibility of Installation!

Notice the course followed by the coal—with four 90° turns—in being conveyed from the bunker at left to the boiler front at right; in the boiler room of the Lantz Sanitary Laundry Co. (note bin-feed mechanism shown in phantom above, and in diagram at right).

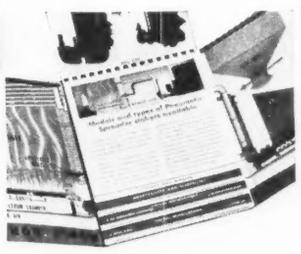
Ask for Survey NOW

The Iron Fireman stoker is *designed, built* and *installed* under the constant supervision of the foremost stoker engineering organization in the world. Iron Fireman gives results no other firing equipment can match.

Iron Fireman may be able to help you cut your steam costs. You may consider your present firing equipment efficient, but a free Engineering Survey may show you how Iron Fireman can do a better job, and pay off the investment in fuel savings and improved performance. Ask for this complete survey now. We invite the collaboration of your plant or consulting engineer. You place yourself under no obligation. Send the coupon below.

IRON FIREMAN

Automatic Coal Stokers



SEND FOR FREE NEW PORTFOLIO

Mail coupon, without obligation, for free copy of new Iron Fireman Pneumatic Spreader portfolio. Simple diagrams of stokers, blueprints and operating data of typical installations.

IRON FIREMAN MFG. CO. (Portland, Ore., Cleveland, Toronto.)

Mail to 3015 West 106th St., Cleveland, Ohio.

☐ Send, free, new Pneumatic Spreader Portfolio.

☐ See us about making, without obligation, an Iron Fireman Engineering Survey.

*Name*_____

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CLOSED
FOR POWER PLANT REPAIRS

HOW MUCH WOULD A *POWER PLANT SHUT-DOWN* COST YOU?

When you take a chance on untreated or improperly treated boiler feed water these days, there's even more at stake than costly repairs. You risk a power shut-down that may cripple your entire plant and add weeks to your production schedules!

That's why so many plant engineers are turning to FERRISUL (anhydrous ferric sulfate) as one sure, safe, and easy way to rid boiler feed water of silica and organic substances—WITHOUT danger of leaving scale-forming or corrosive residuals.

Ferrisul's floc is highly adsorptive, forms immediately, settles rapidly, is stable over the entire pH range above 3.5, leaves no harmful coagulant residuals. Dry and free-flowing, Ferrisul is easy to handle and requires no expensive storage tanks. It can be transferred on any standard conveyor system and introduced into the treatment in standard dry feed machines or solution feeders.

Write today for booklet which gives complete technical details. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

FOR EXPERIENCED TECHNICAL ADVICE

Refer your water treating problems to Monsanto's experienced technical department. Monsanto manufactures a full line of water treating chemicals, is in a position to give sound, unbiased advice on your particular needs.

FERRISUL
FOR BOILER FEED WATER TREATMENT

LET'S GO! U.S.A. KEEP 'EM FLYING!

MONSANTO CHEMICALS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

Power Lines

(*Continued from page* 134)

the General Electric Co in the general superintendent's office at Schenectady. After holding various positions through-

R V Good

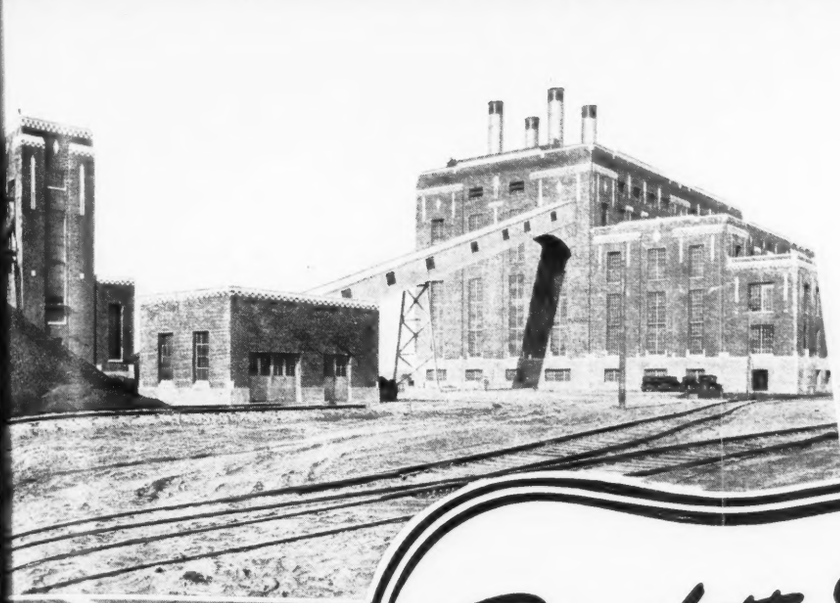
out the company, he was appointed superintendent of the Milling Dept, one of the largest divisions of the G E Schenectady Works. He was transferred to the Philadelphia Works as assistant manager in 1929, and appointed manager in 1936.

COL J CAMPBELL, 72, retired manager of the Salem Terminal Co, died at Salem (Mass.) Hospital, Sept 6. He was a native of Chelsea, Mass., and a graduate of the Massachusetts Institute of Technology.

H L MORRISON, 56, Massachusetts and Vermont representative of the Spencer Turbine Co, Hartford, Conn., died at Suffield, Conn., on Sept 2. He was a graduate of the Worcester Institute of Technology, and was in the machine tool trade previous to his present association.

CHARLES H ROBERTS, 51, treasurer of Johns-Manville Corp, died Sept 10 after suffering from a heart ailment. He began his career as head of the cost department of John A Roeblings Sons Co. in 1907, later serving in various capacities in the financial departments of several companies. He joined Johns-Manville in 1928 as assistant auditor; was made general auditor in the same year, and in 1937 become controller. His appointment as treasurer came the following year.

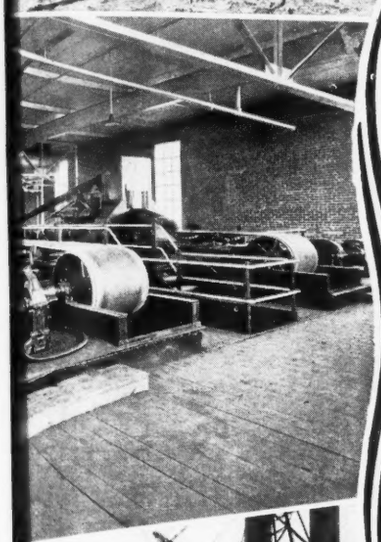
W R C SMITH, founder and chairman of the board of the W R C Smith Publishing Co., Atlanta, Ga., died Oct 7 after a brief illness. He was born near

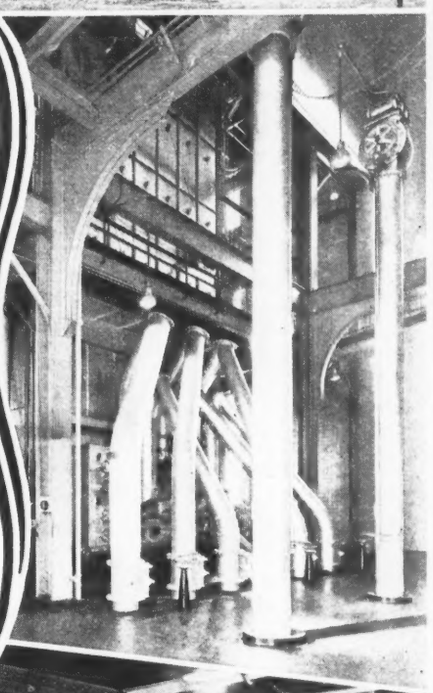


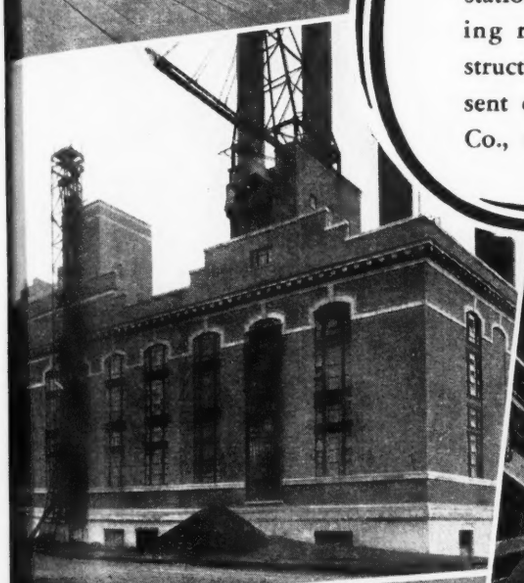
Bartlett·Snow

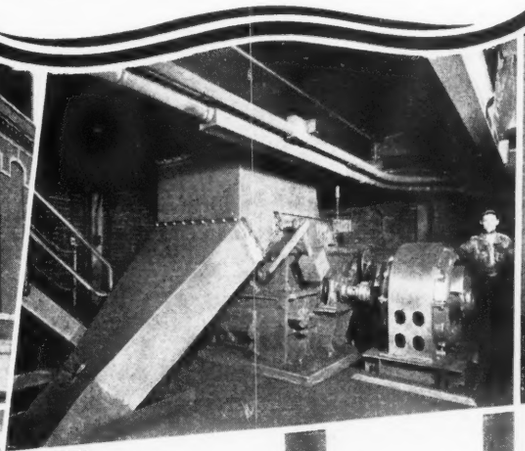
CENTRAL STATION EQUIPMENT

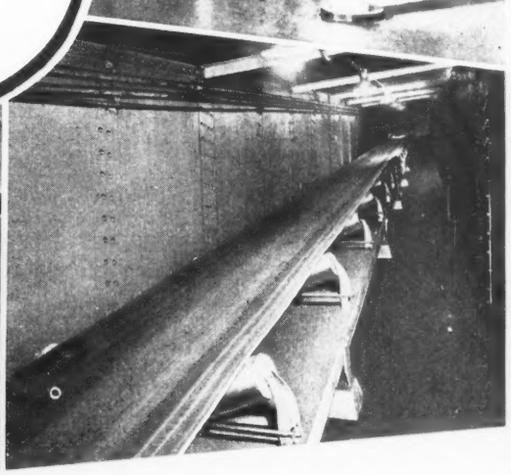
—including rail, boat and truck receiving facilities, large capacity belt conveyors, feeders, bunkers, crushers, distributors, coal storage and reclaiming systems, meets every central station requirement. Eng. Bul. No. 83, describing recent installations and giving construction details of typical equipment units, sent on request. The C. O. Bartlett & Snow Co., 6205 Harvard Ave., Cleveland, Ohio.

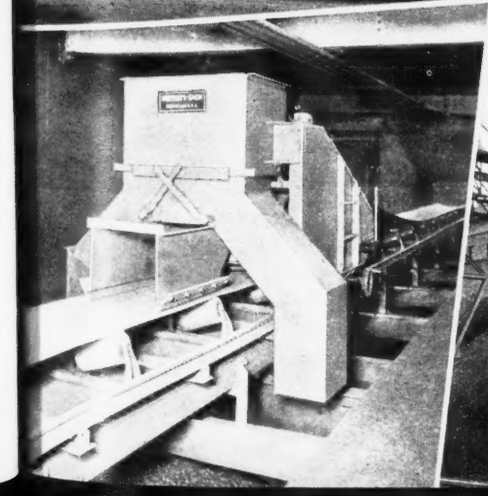


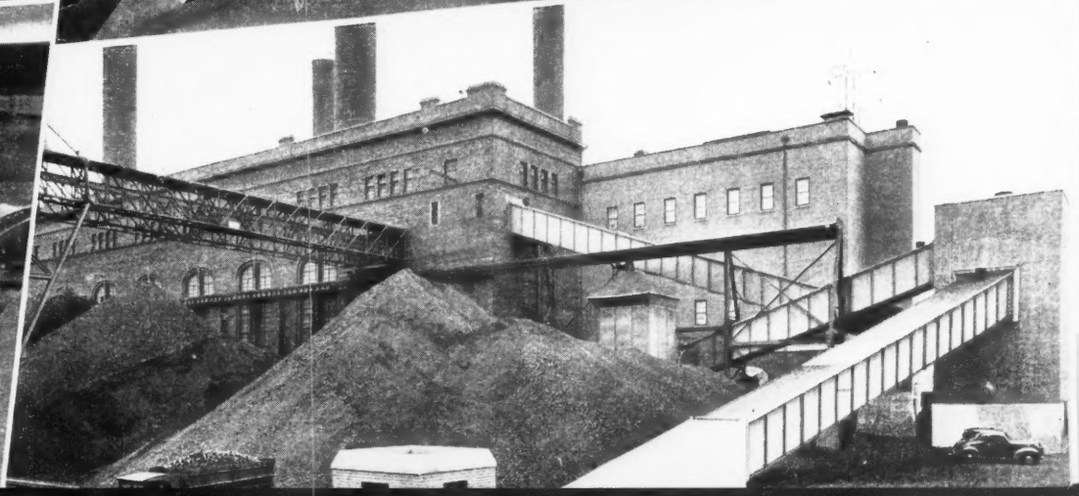




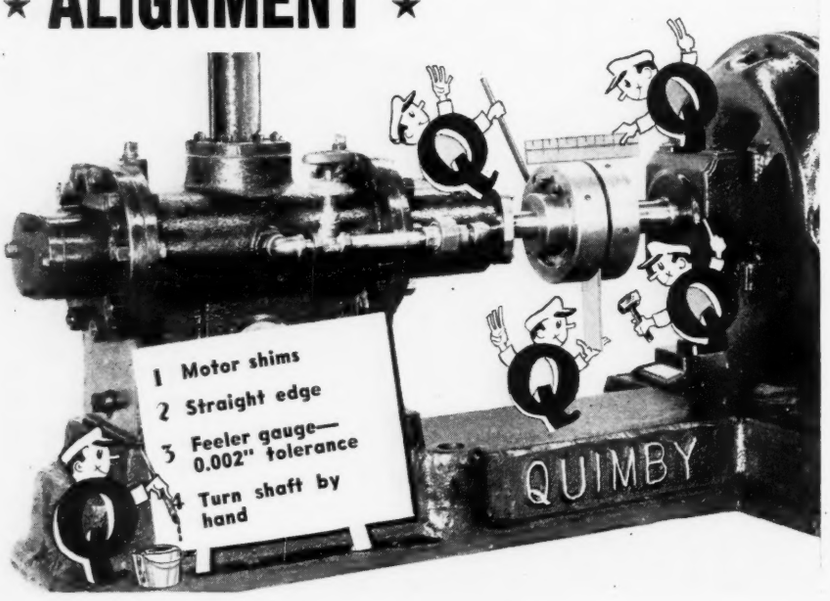








★ ALIGNMENT ★



Pumps and their driving units are properly aligned in our factory before shipment. This perfect alignment can be maintained during installation by shimming and wedging the underside of the bedplate (before grouting, if grout is used).

If misalignment occurs after installation through settling of the foundation or from other causes, motor shims can be adjusted to bring the unit back into alignment. However, this type of adjustment should never be attempted until everything possible has been done to level the bottom of the bedplate. Alignment should be within 0.002″ in accuracy. Be sure that you can turn the flexible coupling by hand easily (larger units require a small bar for turning).

Check alignment frequently, as follows:

1. With feeler gauges on those types of flexible couplings where this is possible or other means to make sure that both faces of couplings are parallel, and
2. With a straight edge against the circumference of the coupling to make sure that the two halves match on centers.

Misalignment will cause unnecessary wear on flexing members of the flexible coupling and excessive leakage at the packing gland.

CONCERNING DELIVERY: National defense priority may cause even our oldest customers some delay in delivery. We earnestly request your patient cooperation until our present expansion program can relieve this situation.

QUIMBY PUMP CO.
INCORPORATED
347 THOMAS STREET
Newark, N. J.

QUIMBY SCREW PUMPS

. . . Good Pumping Practice Since 1894 . . .

New Troy, Mich., studied at Michigan State College, and was associated with the McGraw Publishing Co as an advertising representative. After moving to Atlanta he acquired two southern publications, and consolidated or established fourteen others, creating the five present periodicals, *Cotton*, *Southern Hardware*, *Southern Automotive Journal*, *Electrical South*, and *Southern Power and Industry*.

CHARLES H DEPEW, former superintendent of operations at Niagara, Lockport & Ontario Power Co, Medina, N. Y., died at Ridgeway, N. Y., on Oct 1. He had served in the electric power industry since 1907, prior to his retirement in 1940.

PERSONALS

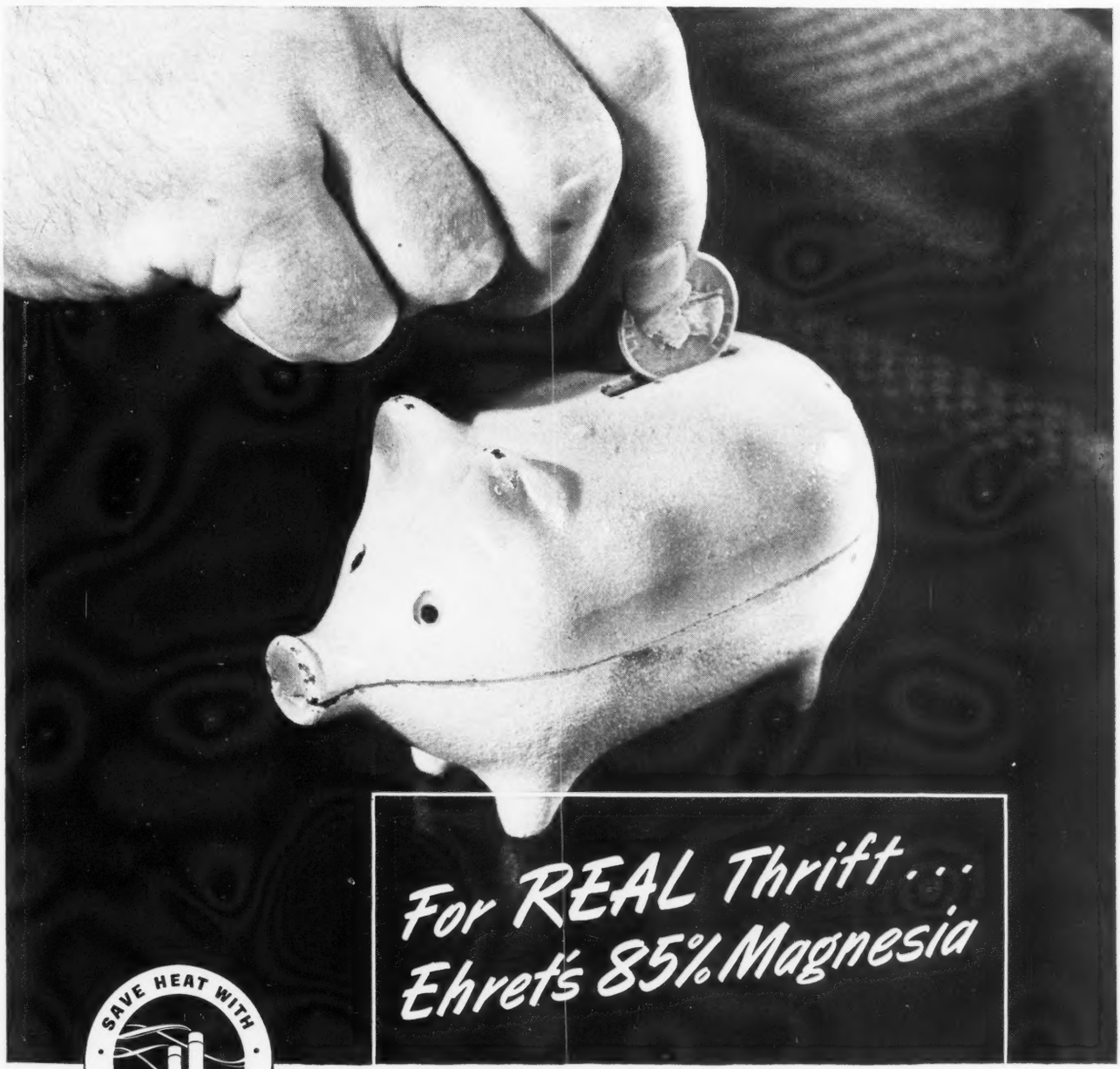
NORMAN H JACOBSON has been appointed director of editorial publicity of the Allis-Chalmers Mfg Co, Milwaukee, Wis. His predecessor, Edward Uehling, is now with the Priorities Div.

Norman Jacobson

ROBERT H BARCLAY, former regional director of the Federal Power Commission, New York, has been engaged as electrical engineer in charge of the Div of Electrical Engineering of the J G White Engrg Corp, New York. He has been with the Foundation Co, Starrett & Van Vleck, architects, Stone & Webster Engrg Corp, and McClelland Barclay Art Products. Since 1934 he has been affiliated with the Federal Power Commission as chief of analysis and reports of the National Power Survey.

PAUL S ELLISON has been appointed director of advertising and sales promotion for the Hygrade Sylvania Corp. He joined the company ten years ago and has held the post of advertising manager and renewal sales manager of the Radio Tube Div.

Insulation Facts · Number 6.



Because of its many advantages, Ehret's 85% Magnesia Insulation provides really substantial savings. Economy of plant operation in the form of fuel saved, together with low overall cost per year of the insulation itself, add up to savings that appeal to the users of this time-tested insulating material.

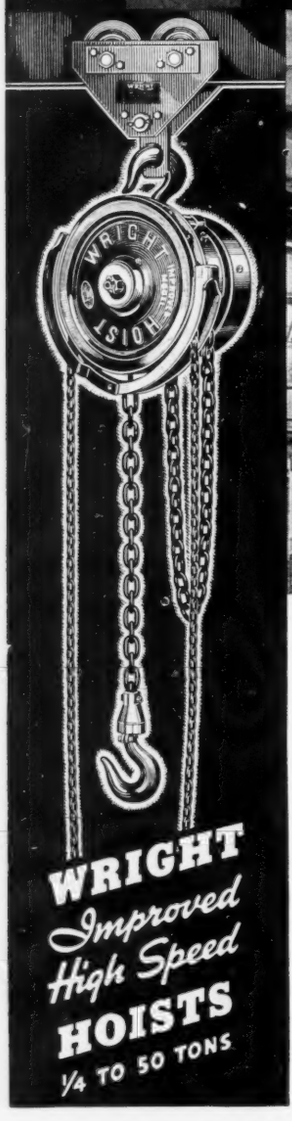
In addition to 85% Magnesia, the Ehret Company provides a full line of industrial insulations. There is an Ehret Contractor or Distributor in every principal city.

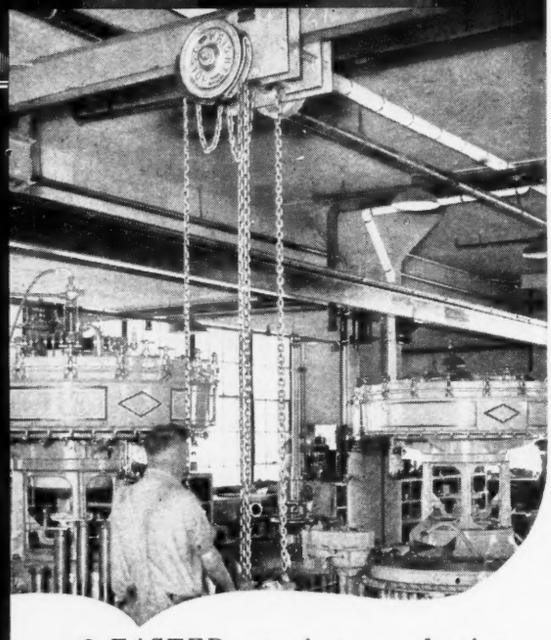
EHRET MAGNESIA MANUFACTURING CO.

VALLEY FORGE · PENNSYLVANIA

MAKERS OF INDUSTRIAL INSULATIONS FOR MORE THAN 40 YEARS

THE WRIGHT WAY TO SPEED PRODUCTION





WRIGHT *Improved High Speed* **HOISTS**
1/4 TO 50 TONS

● *FASTER, ever faster* production is demanded of American industry. One tool that will help speed up your production is the Wright Improved High Speed Hoist.

Wright Hoists are engineered for *fast*, high speed work. Their action is smooth and positive—because of their correct load wheel and driving spindle bearings. They are also *safe* and *economical.*

Ruggedly constructed on precision design, Wright Hoists give you long-time trouble-free service.

As with all ACCO products, safety is an in-built feature. The load chain has a safety factor of 7 to 1. It is made of a special process steel which permits the chain to elongate (under overload) 3″ to the foot before breaking. This same visual factor of safety is inherent in the bottom hook which will slowly open to indicate overload beyond the elastic limit of the chain.

WRIGHT TROLLEYS are made to give the same *fast, economical, safe* service as WRIGHT HOISTS.

WRIGHT MANUFACTURING DIVISION
YORK, PENNSYLVANIA

ACCO

AMERICAN CHAIN & CABLE COMPANY, Inc.
In Business for Your Safety

GEORGE L RANDALL has been appointed advertising manager of the Wickwire Spencer Steel Co, New York. Wickwire Spencer first employed Mr Randall in 1935 as assistant advertising manager. He is a graduate of the University of Michigan.

O A SODERBERG has been transferred from the Philadelphia district office of Combustion Engineering Co, to become manager of the Detroit office. He fills a place left open since W J Vogel transferred to New York as executive engineer.

DEAN R WILSON has been appointed purchasing agent of the Warren, Ohio, plant of the Copperweld Steel Co. He

Dean Wilson

has held in the past positions including vice president of Carbon Steel Co and president of Anchor Drawn Steel Co. His headquarters will be in Warren.

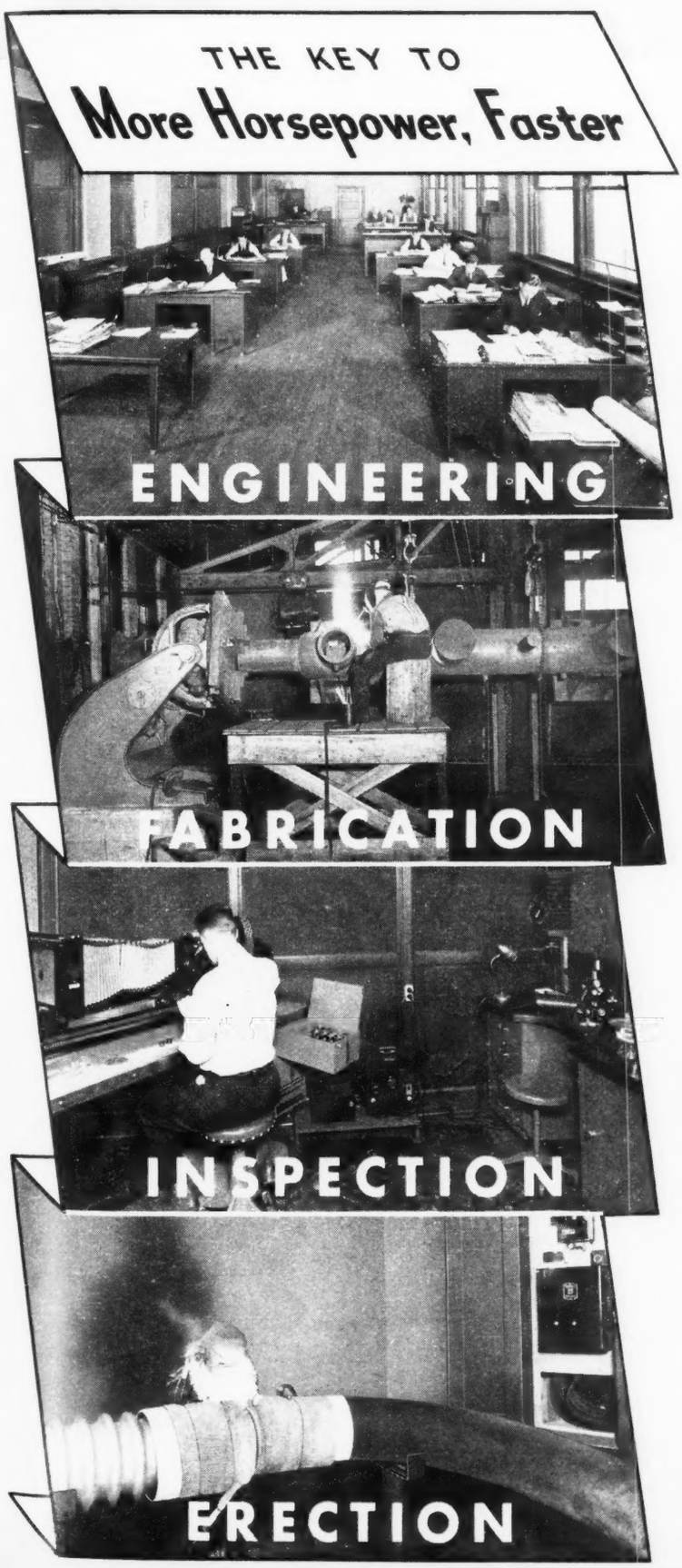
LAWRENCE K BLACKMAN, assistant treasurer of Farrel-Birmingham Co, Buffalo, N. Y., retired from active service September 1 after 43 years of continuous service with the company.

GORDON LEFEBVRE, former American Locomotive Co executive, has been elected vice president and general manager of the Cooper-Bessemer Corp. Mr LeFebvre is a graduate of Virginia Poly-

Gordon LeFebvre

INTEGRATED FABRICATION

from Layout Through Erection



SETTING production schedules and meeting them, in days of priorities, is more than ever dependent upon a logical, well-integrated sequence of operations. Throughout the years Pittsburgh Piping has built up a capable organization trained to make the fullest use of the advantages of pre-fabricated piping.

The Pittsburgh Piping engineering department has experts who are experienced in both the practical and theoretical aspects of central station, industrial and process piping. These men check designs and layouts for safety and maximum operating efficiency. To assure economy and speed, assemblies are detailed to permit as much work as possible to be done under controlled shop conditions without making the individual assemblies too cumbersome for efficient erection.

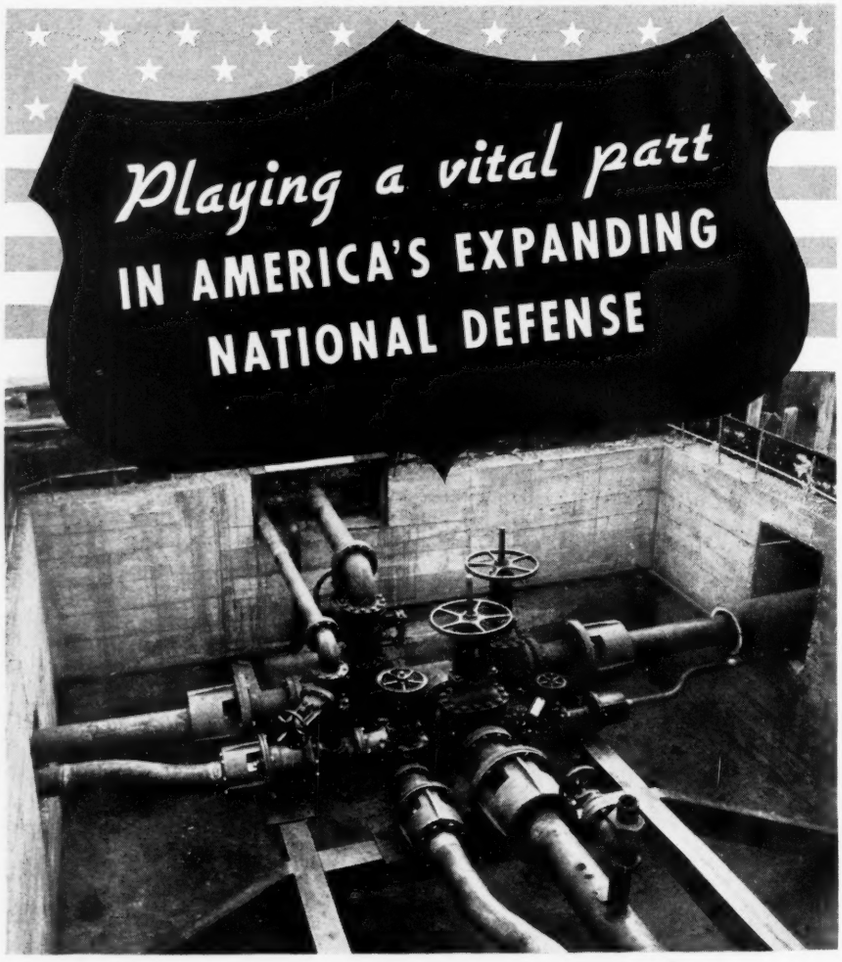
All such assemblies are scheduled through the many shop operations in direct relation to the sequence of their erection in the field. This practice not only simplifies installation but also eliminates time-consuming waiting periods for materials. Field crews are under the direction of highly trained Pittsburgh Piping superintendents who see that schedules are maintained without conflicting with other simultaneous sub-contracting work.

This is no magic formula, but rather a common-sense plan that has been working at Pittsburgh Piping for over 35 years. Your nearest Pittsburgh Piping representative, listed below, will be glad to tell you in detail how it can help speed your piping program today.

PITTSBURGH PIPING & EQUIPMENT CO.
10 FORTY-THIRD STREET **PITTSBURGH, PA.**

Woolworth Bldg., New York · Occidental Bldg., Indianapolis · Peoples Gas Bldg., Chicago · Union Guardian Bldg., Detroit
Public Sq. Bldg., Cleveland · 10 High St., Boston · Liberty Life Bldg., Charlotte · 525 Market St., San Francisco

Pittsburgh Piping



ADSCO

EXPANSION JOINTS

Over 60 years ago, ADSCO originated the idea of District Heating and built the first expansion joint.

Naturally with that period of accumulated experience behind us, ADSCO is rightfully looked upon as the ranking authority throughout the land on expansion joints.

Logically, today ADSCO units are approved and used by the United States Army and Navy from Alaska to Iceland and by national defense industries from coast to coast.

If your requirements include expansion joints, you'll find the breadth of our experience and our line of invaluable aid to you.

Write for Catalog No. 35PR

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

technic Institute, and attended the United States Military Academy at West Point. He will make his headquarters at Mount Vernon, Ohio.

J H SCHENCK has been appointed manager of the Detroit office of the Dampney Co of America. Mr Schenck goes to Detroit replacing Lieut-Comdr C M Boling, now on active duty with the Navy Dept.

LOUIS B NEUMILLER, who began his association with Caterpillar Tractor Co 26 years ago as a stenographer and blueprint clerk in the Engineering Dept, has been elected president of that company. Simultaneous with the advent of

Louis Neumiller

Caterpillar diesel engines, Mr Neumiller was advanced to general service manager. He became sales manager for the Central Div in 1937, director of industrial relations six months later, and a vice president of the company five months after that. As vice-president, a position he held until his elevation to the presidency, Mr Neumiller was in charge of Service, Parts, Industrial Relations and Training and Public Relations Departments.

WALLACE W LOCKWOOD has been appointed advertising manager of the Taylor Instrument Cos, Rochester, N. Y. A graduate of Auburn High School and Syracuse University, Mr Lockwood joined the Taylor advertising Dept in 1932 and was made assistant advertising manager in 1939. He replaces Elmer E Way, who resigned.

ELMER ISGREN, former LeTourneau plant superintendent, has been appointed manager of the entire LeTourneau factory at Peoria, Ill. He succeeds Ray Peterson, vice president and plant manager, who resigned recently to conduct business on the West Coast. Mr Isgren started with the company in 1930 and came to the Illinois plant from the

Vital for Defense

Efficient and economical plant operation is vital to attain the unprecedented production levels demanded by the National Defense program.

The dependability and long life built into every GARLOCK quality product today, as always, contributes to efficient plant operation by reducing production time losses due to shut-downs for frequent replacement of packings and gaskets.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

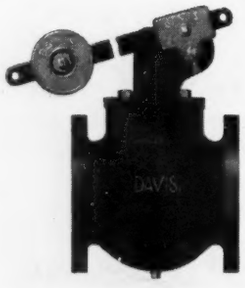
Garlock Packings

Automatic
RELIEF VALVES

THE DAVIS LINE (Standard Items)		For Steam, Air and Gas *Also Water and Oil											For Steam								
Valve No.		13R	14R*	15R	16R*	18R*	19R*	49	180R*	182R*	260	261*	401	80	81	82	110 118	111 112	113	113B	116 117	118B	265
Service	Pressure Relief to Atmosphere												✓	✓	✓	✓				✓		✓	
	Pressure Relief into L. P. Lines		✓	✓	✓																		
	Vacuum Relief		✓	✓	✓	✓	✓																
	Pump By-Pass	✓							✓														
	Protection of Major Equipment										✓	✓					✓	✓	✓	✓	✓	✓	✓
Max. Relief Pressure		100	150	30	125	50	100	200	150	500	50	15	500	20	20	20	Atmos.	Atmos.	Atmos.	10	Atmos.	10	250
Single Seat		✓				✓	✓	✓			✓	✓					✓	✓	✓	✓	✓	✓	✓
Double Seat			✓	✓	✓			✓	✓	✓			✓	✓	✓	✓							
Diaphragm Actuated		✓	✓	✓	✓	✓	✓		✓														
Piston Actuated										✓													
Direct Disc Actuated											✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Auxiliary Pilot Control								✓					✓										
Spring Loaded		✓	✓				✓	✓	✓	✓	✓	✓	✓										✓
Weight Loaded				✓	✓	✓								✓	✓	✓				✓		✓	
Range of Sizes, Scr'd.		⅜" 2"	½" 4"	½" 4"	½" 4"	¼" 4"	½" 4"	½" 4"	½" 4"	½" 4"	2" 4"	2" 4"	½" 4"	2" 6"	2" 6"	2" 6"							
Range of Sizes, Fl'g'd.			¾" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 4"	1½" 4"	2" 8"	2" 8"	1½" 14"	2" 24"	2" 24"	2" 24"	6" 30"	6" 48"	6" 30"	6" 30"	6" 30"	6" 30"	4" 20"
Material Specifications Body	Bronze	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓										
	Semi-Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓										✓
Trim	Bronze	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nickel Iron		✓		✓			✓					✓										
	Monel	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓										✓
	Stainless Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓										✓

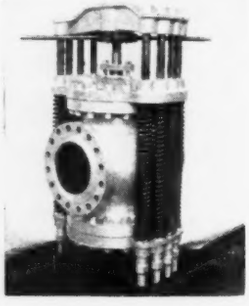
for ***Every Job***

PRESSURE RELIEF • VACUUM RELIEF
ATMOSPHERIC RELIEF • PUMP BYPASS



Above—No. 80 "Noiseless" semi-balanced Back Pressure Valve for exhaust lines.

USE the check list above to determine the proper type of relief valve for your job. It lists valves suitable for every relief service, including valves designed for full pipe capacity at rated relief pressure with minimum accumulation. Hand testing levers may be incorporated on most designs. Manual control and stay-open features are available on atmospheric relief valves. Send data on your service conditions for complete recommendations on the proper valves for your plant. DAVIS REGULATOR CO., 2540 S. Washtenaw Ave., Chicago, Ill.



Left — No. 265 Turbine Bleeder Relief Valve with spring loading. Available in a full range of sizes for pressures from 5 to 200 lbs.

Right—No. 110 Exhaust Relief Valve for condenser relief to atmosphere. Available in horizontal, vertical and angle patterns.

DAVIS REGULATOR COMPANY

Elmer Isgren

Moss Avenue shop at Stockton, Calif. in 1935. He was promoted to plant superintendent in 1937.

STANLEY BRACKEN has been appointed general manager of the manufacture of the Western Electric Co. Mr Bracken has been with Western Electric for 29 years. He has held several responsible positions in the company, and prior to his recent appointment was engineer of manufacture.

EDGAR F HECKERT has been appointed special assistant to general works manager of the York Ice Machinery Corp. advancing from his previous position as

Edgar Heckert

manager of the Service Dept. His new assignment will include studies in the Manufacturing Div, designed to increase efficiency and production output

HARRY J LEHMAN has been appointed to succeed the late H B Whitaker as Providence district manager of the Bridgeport Brass Co. Before joining the company last year as a salesman in the Boston and Providence district, Mr Lehman had been district sales manager in the territory for the Scovill Mfg Co.

HARRY G JOHNSON has been appointed territorial salesman of Manning, Maxwell & Moore of Bridgeport, Conn.

ALLOYS

Timely information about metals . . .
CATALOGUED for your convenience

Specific answers to many of your questions about the selection, fabrication and uses of Nickel alloys are available to you quickly from our files.

This fund of helpful information we have gathered, checked and condensed into convenient printed form. The graphs, charts and shop guides are especially useful to men handling new materials or performing unfamiliar operations . . . and to new employees. This literature is available on request.

You are also offered the assistance of our technical staff in solving material problems arising from a temporary lack of Nickel. These engineers are offering timely suggestions to many vital industries during the present emergency.

Why not drop us a card asking for list of available literature. Your request for the assistance will receive prompt attention.

NICKEL

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

Users of CITIES SERVICE LUBRICANTS

get an EXTRA ADVANTAGE with HEAT-PROVER SERVICE

Heat-Prover Service is now available to users of Cities Service Industrial Fuels and Lubricants. This is an economy measuring service which you can secure in addition to the quality and economy advantages offered by Cities Service's SERVICE PROVED Fuel and Diesel Oils.

The Heat-Prover is an ingenious device — a by-product of our research in metallurgy. It registers continuously and instantaneously changes in the amount of oxygen and combustibles in furnace gases. It is an excellent guide in adjusting 4-cycle Diesels and for combustion control in heat generating plants. In the heat treatment of metals, it is invaluable. It assures uniformity and reduces scrap losses.

Let us tell you how you can secure the use of one of these machines. Mail the coupon today for further information.

CITIES SERVICE OILS
ONCE-ALWAYS
DIESEL
LUBRICANTS

***FREE*—Just clip and mail**

CITIES SERVICE OIL COMPANY
Room 1326, Sixty Wall Tower, New York

Please tell me how I can get Heat-Prover Service in my shop. PR.

Name .....

Name of Shop .....

Address .....

City ..... State .....

in the Indianapolis, Ind., territory. Mr Johnson will handle product sales for all four Bridgeport divisions.

JACK W GREEN has been appointed manager of the Chicago office of Tube-

Jack Green

Turns, Inc, Louisville, Ky. He has been associated with the company in both the Louisville and Chicago offices.

BUSINESS ITEMS

BIRD-ARCHER CO. New York, announces the appointment of G C Walker as sales manager. Mr Walker was formerly district manager of W H & L D Betz. H C Stevens was at the same time appointed representative in the Connecticut territory.

BRISTOL CO. Waterbury, Conn., announces transfer of H R Bristol from Chicago to Boston office. J E Booth will take over territory in the Chicago district vacated by Mr Bristol.

WILKENING MFG CO. Philadelphia, Pa., announces that Gray and Rogers will direct company advertising, promotion, and merchandising.

MONSANTO CHEMICAL CO announces several personnel changes. Arthur P Kroeger was promoted from assistant general branch manager of the Los Angeles office to assistant manager of sales in charge of intermediates, with headquarters in St Louis. Charles L Fetzner has been transferred from the San Francisco office to the Los Angeles office as assistant branch manager, replacing Mr Kroeger.

H T CANFIELD ENGINEERING ASSOCIATES has been established at 61 Broadway, New York. New organization will give attention to problems involved in the integration of utility systems and changes of ownership.

Steam

★ You get the exact amount of steam you need

—NO WASTE

★ The rate of fuel feed is adjusted exactly to load requirements

—NO WASTE

★ Flue Damper is changed in accordance with furnace conditions to prevent combustion losses due to excess air

—NO WASTE

Simple Way to STOP WASTE in the Boiler Room . . .

CASH STANDARD

AUTOMATIC COMBUSTION CONTROL SYSTEMS

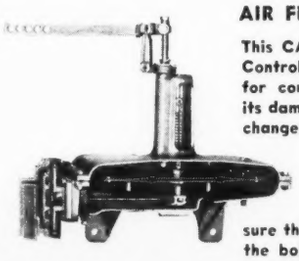
Meet any condition • Work on any Boiler

Each of the units shown is available in a number of variations to suit different requirements. Combinations can be arranged so that the full benefits of CASH STANDARD Automatic Combustion Control with its attendant savings can be realized by any plant even though it be a small one.

Try draft control—one part of the complete system—first, to experience for yourself how your fuel bill can be cut and yet how you get more steam. The Furnace Draft Controller installed separately gives you this opportunity. The rest of the CASH STANDARD Automatic Combustion System can be added later to give you the full cost savings that such systems make possible.

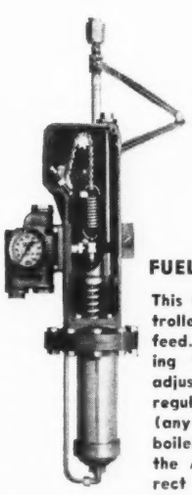
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber. Place it near the uptake damper. It works independently of either of the fuel feed and air flow Controllers. If it only eliminated wasteful air infiltration it would be a profitable investment.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

Bulletin No. 300 gives full details on Automatic Combustion Control for steam plant economy and shows applications of these systems for those who burn coal, oil, or gas.

OIL CIRCULATOR

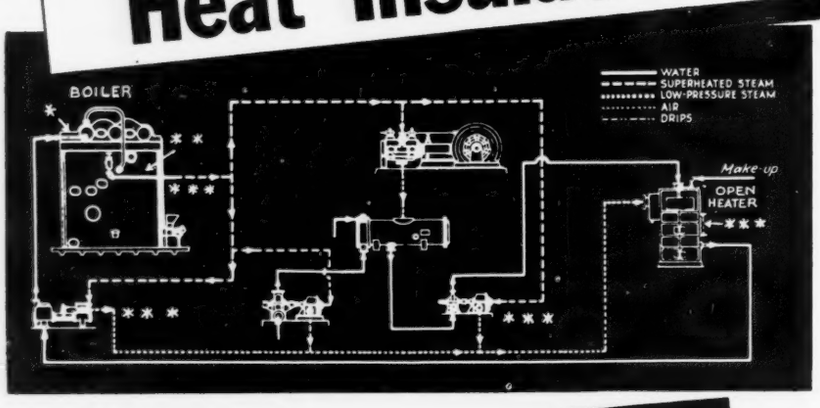
The purchase of this oil circulator is optional. All three Controllers shown above can be properly operated by clean water, but it is preferable and cheapest in the long run to operate with this CASH STANDARD Oil Circulator equipped with 110-220 v. 60 cy. motor.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES

Wherever Steam is Produced There's Need for

BALDWIN-HILL Heat Insulation



Here's a typical small plant using exhaust steam from steam driven auxiliaries for heating feed water. We've marked a few of the most important points where there's need for Baldwin-Hill insulation to prevent wasteful heat losses; to eliminate lag in production; to maintain close control and provide more uniform operating temperatures.

Baldwin-Hill insulations meet the most rigid specifications and cover the entire field from sub-zero to high temperature requirements.

For any problem in stepping up the efficiency of your hot equipment, call in a Baldwin-Hill insulation engineer. He'll fit the insulation to your particular job.

BALDWIN-HILL CO.
575 Klagg Ave.,
Trenton, N. J.
New York . . . Boston . . . Chicago
Kalamazoo, Mich.

B-H

* **B-H Rockwool BLANKET**
Effective to 1200° F. Fabricated of chemically stable B-H black rockwool in 12 styles utilizing various types of metal fabrics. Standard sizes: 2' x 4'; 2' x 8'; 1" to 8" thick.

** **B-H MONO-BLOCK**
Effective over the full temperature range up to 1600° F. Black rockwool fibres, felted and bonded together, are uniformly distributed to give maximum efficiency. Standard sizes: 18" to 36" long; 6" to 18" wide; 1" to 4" thick.

*** **B-H No. 1 Insulating CEMENT**
Effective up to 1800° F. and 100% reclaimable up to 1200° F. A plastic material with exceptionally high coverage and low volume shrinkage. Packed in 50 lb. bags.

A Complete Line of Heat Insulation Products

B-H

B-H Black Rockwool BLANKET . . . B-H MONO-BLOCK
B-H No. 100 PIPE COVERING . . . B-H MINERAL FELT
B-H No. 1 INSULATING CEMENT . . . B-H WEATHERSEAL
and other heat insulations effective up to 2000° F.

INTERNATIONAL PAPER & POWER Co terminated its activities at close of business October 4th. This marked completion of program to substitute a single company—the new International Paper Co—for both International Paper and Power Co and the original International Paper Co.

GENERAL ELECTRIC Co, Schenectady, N. Y., announces numerous changes in organization personnel. S W Scarfe has been appointed assistant manager of the Los Angeles Central Station Department. He has been with the company since 1924, when he became sales assistant in the San Francisco office. Since 1939, Mr Scarfe has been a member of the company's Los Angeles district. H A Jones has been named manager of sales of General Electric electronic tubes for non-radio applications in industry. The Industrial Tubes Div has been transferred from the Special Products Section of the Industrial Dept to the Radio and Television Dept. Dr Jones assumed his new duties on October 1st. Truman G Glenn, formerly assistant district engineer in the company's Central District, has been appointed engineer of Detroit office. Mr Glenn succeeds Thomas E Nicoll, who retired October 1st after more than 38 years with the company. Mr Glenn joined General Electric in 1922. Robert Paxton has been made manager of the company's Philadelphia Works. He has been assistant to the late R V Good since October 1940. W C Hutchins has been appointed manager of sales of the Special Products Section of the Industrial Dept, succeeding Dr H A Jones, now in charge of non-radio electronic tubes. Mr Hutchins is a graduate of Clemson College, class of 1928, and joined General Electric the same year.

CATERPILLAR TRACTOR Co has announced that T J Connor, vice-president, is assigned to general supervision of the Industrial Relations Dept and Training and Public Relations Dept in addition to the departments of manufacturing, engineering, and purchasing, which he had previously administered. T R Farley has been assigned direction of the Parts and Service Depts, which duties he will handle in addition to the direction of the Merchandising Dept. General supervision of the Traffic Dept, formerly conducted by Mr Farley, will be taken over by William Blackie, company controller.

ROLLER-SMITH Co, Bethlehem, Pa., announces appointment of Electrical Jobber Equipment Co, Minneapolis, Minn. as sales agent. The company will

MORE PRECIOUS THAN SILVER OR GOLD

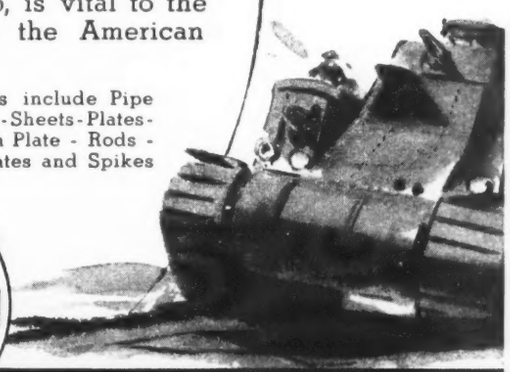
Less than a thousand years ago, steel was a precious metal. Kings and emperors gave for fine Damascus blades, more than their weight in gold.

In the world conflict today, steel is the precious metal that protects America. While a large part of the earth's gold lies buried in the Kentucky hills, steel in thousands of shops is being fashioned into weapons and equipment of war for the preservation of our way of life.

Defense is first with every thinking American. So every customer will approve of the fact that a steadily increasing part of Youngstown's output of finished and semi-finished steel is going for defense purposes. At the same time, we are delivering every ton we can for domestic use - for that, too, is vital to the preservation of the American way of life.

Youngstown products include Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes

25-26D



QUALITY TRADE MARK YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steels

General Offices - YOUNGSTOWN, OHIO

GET THIS SEAL

HYDRAULICALLY BALANCED

ON THE PUMPS YOU BUY

It means...

LONGER LIFE

because the ROPER flanged bronze bearings act as wear-plates — absorb all wear ordinarily placed on face and back-plate.

QUIETER OPERATION

because the pumping gears actually "float"—equalizing internal pressure at all points.

HIGHER EFFICIENCY

because tests prove that Roper "hydraulically balanced" pumps top competition in mechanical and volumetric efficiency.

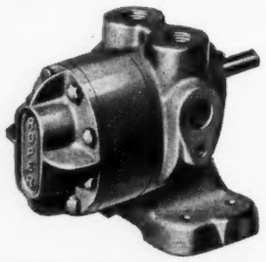
MORE DEPENDABLE PERFORMANCE

because only quality material and workmanship go into Roper Pumps—Dependable since 1857.

Write for Catalog 944

with illustrations, cutaway views, drawings, dimension and pumping capacity tables, and complete information on Roper Pumps.

GEO. D. ROPER CORP.
ROCKFORD, ILLINOIS



QUICK FACTS

1. **LARGE BRONZE BEARINGS** —two on each side.
2. **SPIRAL PUMPING GEARS** —perfectly machined and run-in.
3. **CONSTANT LUBRICATION** —(1) by liquid being pumped and (2) by lubricating qualities of the bearing metal used.
4. **WEAR PLATES** protect face and back plates from wear by foreign matter.
5. **THRUST COLLAR** on drive shaft plus sliding joint takes up shock and thrust.
6. **FOUR PIPE OPENINGS** provide eight different piping arrangements.
7. **MECHANICAL SEAL** reduces power requirements and keeps leakage to minimum.
8. **SPLINED DRIVE SHAFT** forms sliding joint with gear to absorb shock and thrust.
9. **ALWAYS PRIMED** — after once primed and in operation.
10. **ONE PIECE BACKPLATE** protects working parts from stress and strain.

ROPER *Rotary* PUMPS
DEPENDABLE - SINCE 1857

handle the entire Roller-Smith line of products.

Corporate name of HydroCarbon Chemical and Rubber Co, Akron, Ohio, jointly-owned enterprise of B F Goodrich and Phillips Petroleum Co's, has been changed to Hycar Chemical Co. The firm now manufacturing synthetic rubbers in Akron has in addition been recently designated by the Defense Plant Corp to build and operate another synthetic rubber plant at Louisville, Ky.

J W Parker New ASME President

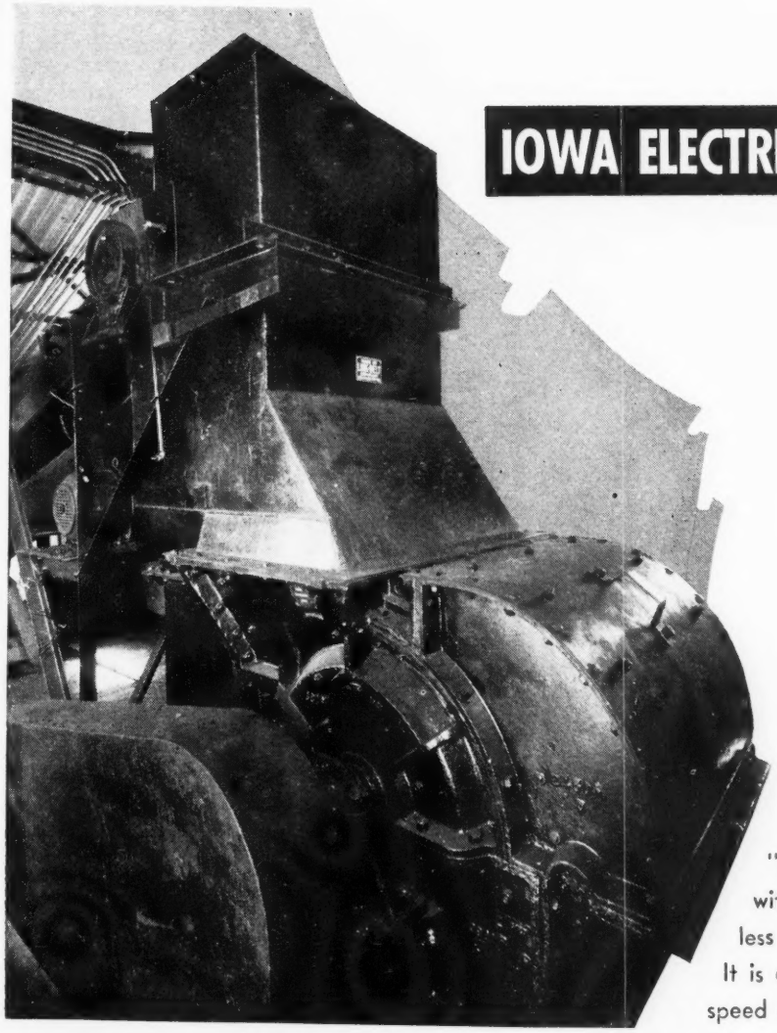
James W Parker, vice-president and chief engineer of the Detroit Edison Co, was elected by a letter ballot of the 15,000 members of The American Society of Mechanical Engineers to be president of the Society during 1942, according to the official announcement of the election results by C E Davies, secretary.

Vice-presidents elected at the same time to serve 2-year terms on the Council of the ASME were Clarke F Freeman, senior vice-president and engineer of the Manufacturers Mutual Fire Insurance Co and its associated companies,

James Parker

Providence, R. I.; C B Peck, managing editor of *Railway Mechanical Engineer*, New York, N. Y.; W H Winterrowd, vice-president of The Baldwin Locomotive Works, Eddystone, Pa.; and W R Woolrich, dean of the College of Engineering, and director of the Bureau of Engineering Research of the University of Texas, Austin, Texas.

Managers of the Society elected to serve on Council for 3-year terms include W G Christy, smoke-abatement engineer of Hudson County, New Jersey; H L Eggleston, manager of the gas and refining departments, Gilmore Oil Co, Los Angeles, California; and T S McEwan, who was last year selected



IOWA ELECTRIC LIGHT & POWER CO.

. . . another prominent plant to size coal at low cost . . . the **"AMERICAN" WAY**

Proper preparation of coal for better combustion and attendant savings is assured at the Cedar Rapids, Iowa, plant of the Iowa Electric Light & Power Company by an "American" Ring Crusher. This 30S "American," with a capacity of 150 tons P.H., handles 12" and less run of mine coal, crushing it to ¾" and finer. It is driven by a 60 H.P. motor and operated at a speed of 720 R.P.M..

THIS AMERICAN FEATURE
insures proper sizing

An exclusive "AMERICAN" development, this reversible manganese steel shredder ring provides the means for splitting the coal instead of crushing it. Whether coal is to be prepared for stoker or pulverized fuel firing, proper sizing is assured and easily controlled for specific operating conditions.

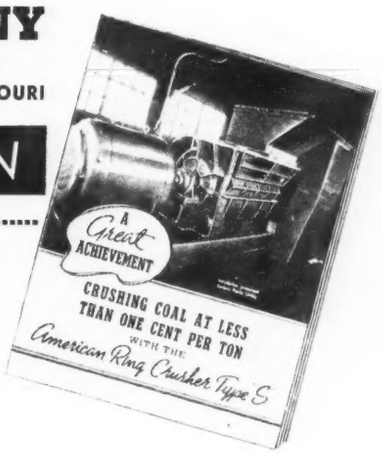
Many other prominent plants have installed "AMERICANS" to cut steam costs. These plants have found also by experience that the "AMERICAN" way is the economical way to size coal because of low crushing and maintenance costs. An average for all charges is less than 1¢ per ton, while fuel bills are being reduced from 2½ to 8%.

Your plant may offer just as great an opportunity for savings. The probability that the "AMERICAN" way will result in improved combustion is such as to justify your asking "AMERICAN" engineers to study your conditions and submit recommendations. Investigate today!

AMERICAN PULVERIZER COMPANY

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1349 MACKLIND AVE. ST. LOUIS, MISSOURI

MAIL COUPON FOR NEW BULLETIN



AMERICAN PULVERIZER CO. 1349 MACKLIND AVE., ST. LOUIS, MO.

Gentlemen:
Kindly send me (without obligation) a copy of your NEW Bulletin "Crushing Coal At Less Than One Cent Per Ton."

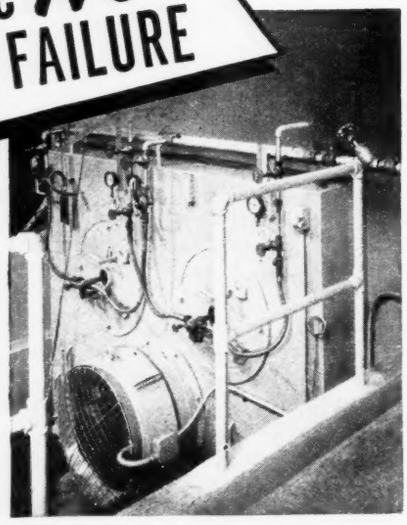
Name .....

Position .....

Company .....

Address .....

...There must be NO MECHANICAL FAILURE



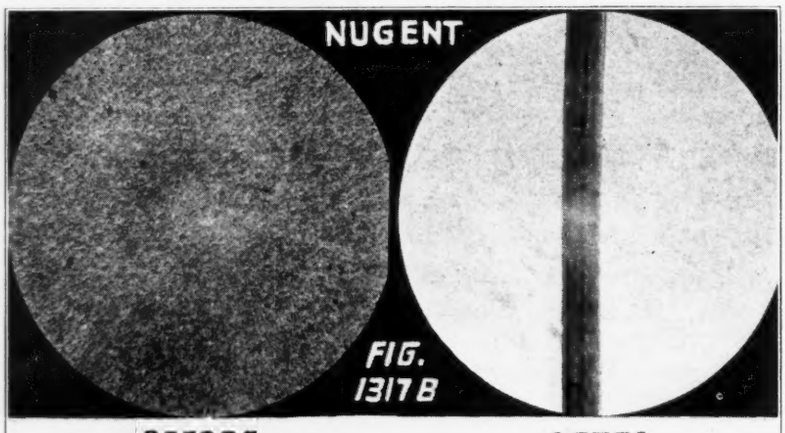
PRESENT demands require, more than ever, that a boiler STAY "on the line" for long, uninterrupted periods. Where oil fuel is used, this calls for absolute dependability on the part of the oil burning equipment . . . there must be no mechanical failure.

The success of Enco Oil Burning installations lies in the proper coordination of the many details involved—efficient burners properly selected and applied—dependable Oil Pumping and Heating Equipment provided with all automatic controls for delivering the fuel oil at the correct temperature and pressure, together with all safety devices against improper operation.

We will be glad to send you Bulletins OB-40 and 37 describing ENCO Oil Burning, Pumping and Heating Equipment.

THE ENGINEER COMPANY
75 WEST STREET (Enco) NEW YORK, N.Y.

HERE'S PROOF of the *Oil-Cleaning* Ability of Nugent Filters



BEFORE *AFTER*

MICROSCOPIC PHOTO 100-X

This photomicrograph illustrates how Nugent Filters remove harmful grit, dust, sand, carbon, and abrasives of all types, from oil used in Diesels, gas engines, compressors, turbines, oil burners, etc. The lube oil samples shown above were taken *before* and *after* a Nugent Absorbent (Waste) Type Oil Filter was installed on a 600 H.P. Diesel engine. The "after" sample was taken at 1800 hours operation. The line which appears in the "after" view is a human hair. The large dirt particles in the "before" sample are about .0003" thick. Get the facts about Nugent Filters today.

WM. W. NUGENT & CO., INC., Established 1897
402 N. Hermitage Ave., Chicago, Illinois

to head the defense contract service of the Office of Production Management in Chicago as district manager.

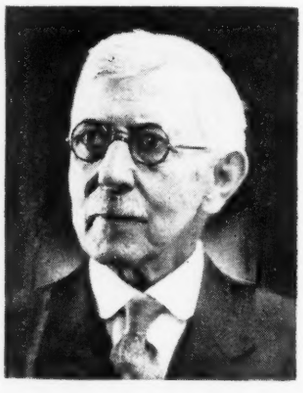
The new officers will be installed during the 62nd Annual Meeting of the Society in New York, N. Y., at the Hotel Astor, December 1–5, 1941.

Charles L Clarke Dies; Was Edison Associate

Charles L Clarke, 88, retired consulting engineer of the General Electric Co, died October 9 at his home in Newton, Mass. He was the oldest surviving former associate of Thomas A Edison.

Mr Clarke was born in Portland, Me., and studied at Bowdoin College, from which he was graduated in 1875. He worked for Mr Edison from 1880 to 1884, his assignment consisting mainly of designing electric generators and other apparatus for the inventor's first commercial system of lighting.

In 1882, Mr Clarke designed the famous Jumbo dynamos, and supervised the mechanical engineering involved in the construction and operation of the Pearl Street central station in New York. When he left the employ of the early Edison system Mr Clarke became engineer for the Telemeter Co of New York, and then the Gibson Electric Co, engaged in the development of storage batteries.



Charles Clarke

From 1901 to 1911, he served as engineer for the Board of Patent Control of the General Electric and Westinghouse Co's. In 1911, he was appointed consulting engineer of the General Electric Co, a position which he held until he retired ten years ago.

Mr Clarke was the last of 71 charter members of the American Institute of Electrical Engineers and one of the five remaining persons of the 28 who formed the Edison Pioneers organization in 1918. He was also a member of the American Society of Mechanical

This remarkable insulating cement is lastingly effective

EAGLE SUPER "66" RETAINS FULL EFFICIENCY YEAR AFTER YEAR BECAUSE IT IS CHEMICALLY AND PHYSICALLY STABLE

Why are more and more industrial and power plants insulating large heat producing and heat transmitting equipment with Eagle Super "66"?

That's easy to explain . . .

1. Low-cost installation. This unique plastic insulation is quickly and easily applied with a trowel. Tests show extremely high *dry* coverage—50-55 sq. ft. per 100 lbs.

2. Top efficiency. Eagle Super "66" is composed of small mineral wool pellets. These pellets have a "springy ball" structure—they do not crush down or flatten when applied to the job. Maximum heat savings are assured for a full range of temperatures—as high as 1800° F.

3. No deterioration. Because Eagle Super "66" is chemically and physically stable, it loses none of its efficiency during service. It is as effective the tenth year as it is the first month. It sticks on like glue—withstands normal contraction and expansion of heated surfaces without cracking. Does not cause or accelerate corrosion, even when wet.

4. Fully reclaimable. Eagle Super "66" can be removed, re-mixed and re-applied when used at temperatures below 1200° F. Repair work on equipment is facilitated.

Supplied in 50-lb. bags. Write today for complete specifications and free samble.

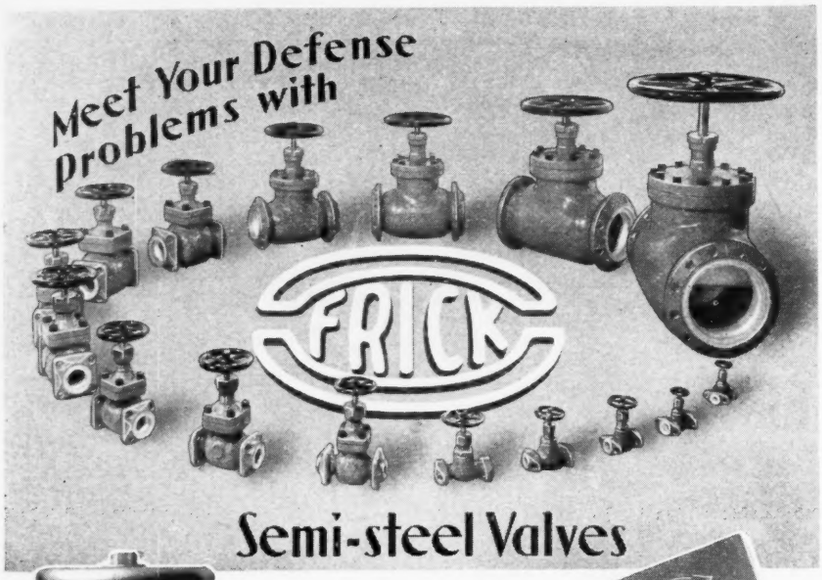
Eagle Insulating Materials include . . .

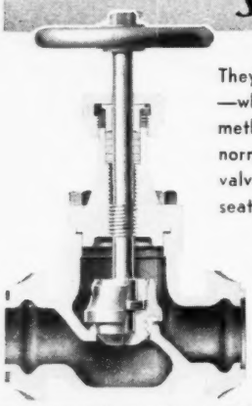
EAGLE SUPER "66" CEMENT
EAGLE SUPERTEMP° BLOCKS
EAGLE L-T FELTS
EAGLE BLANKETS
EAGLE LOOSE WOOL
EAGLE INSULSEAL
EAGLE INSUL-STIC
EAGLE FINISHING CEMENTS

See Sweet's Catalog for specifications

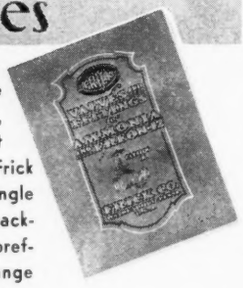
EAGLE EP PICHER

THE EAGLE-PICHER LEAD COMPANY · CINCINNATI, OHIO



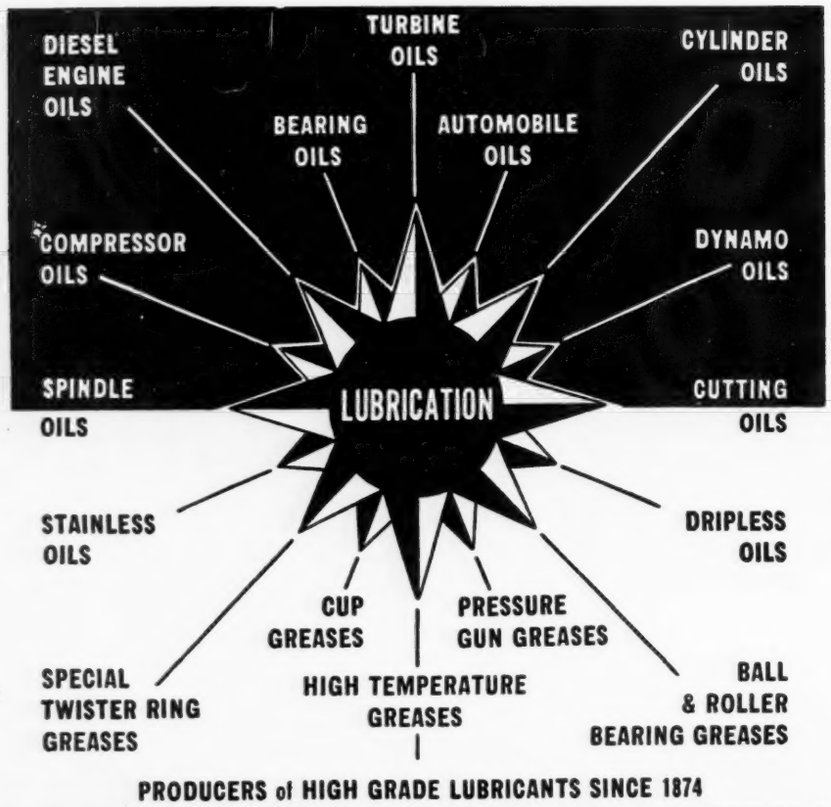


They hold pressures up to 300 lb. gage —whether handling ammonia, Freon-12, methyl chloride, CO_2 or natural gas, at normal or low temperatures. Only in Frick valves do you get the patented high-angle seat, alloy-faced button, and easy repacking which have given them the preference for generations. . . . Full range of sizes, 1/4" to 14". Screwed valves up to 2". Stocked by Frick Distributors in principal cities everywhere . . .



Ask for Catalog K
Your copy is waiting

Write to **FRICK CO., Waynesboro, Pa.**



PRODUCERS of HIGH GRADE LUBRICANTS SINCE 1874

BORNE SCRYMSER COMPANY
ELIZABETH · NEW JERSEY

Engineers, the New York Electrical Society and several others.

L H Morrison Passes

Lacey H Morrison, Editor of *Diesel Power* since 1931, and before that Associate Editor of POWER for 11 years, died at his home in Port Washington, New York, on September 20, as the result of a heart attack.

An engineering graduate of the University of Missouri (1907), Mr Morrison served in the first World War as a lieutenant in the Ordnance Dept USN. During his eleven years on the staff of POWER, he handled hundreds of articles relating to diesel engines and refrigeration, his special fields. His published books included "Oil Engines—Details and Operation" (1919), "Diesel Engines" (1923), "POWER's Practical Refrigeration" (1928), "American Diesel Engines" (1931, 1939). He also edited "Diesel Operators' Guide" and "Diesel Engineering Handbook."

From his first connection with the American Society of Mechanical Engineers as an associate member in 1918, Mr Morrison played an active role in the affairs of the Society, especially in the Oil and Gas Power Div. In 1921, he was largely responsible for revitalizing and reorganizing this division, which had been known as the Gas Power Div. From 1923 to 1930 he served as secretary of the Div, was a member of the Executive Committee from 1936 to 1940 and was chairman in 1930. From 1931 to 1935, and from 1940 until his death, Mr Morrison was an associate member of the Executive Committee.

His keen interest in the oil-engine field was evidenced by activity on several research committees. From 1931 to 1936 he served as a member of the subcommittee of the Oil and Gas Power Division, ASME, which was responsible for the preparation of the annual Oil Engine Power Cost Report. In 1930, Mr Morrison acted as chairman of the ASME Research Committee on Diesel Fuel-Oil Specifications and from 1930 to 1938 he served as vice-chairman of the ASTM Technical Committee on Fuel Oils and as chairman of Section II on Diesel Fuels. On the reorganization of this activity in 1938, he became a member of Technical Committee F on Diesel Fuels.

Aside from the ASME, in which Society he was a full Member from 1935, Mr Morrison was a member of the SAE from 1936 and in 1938–39 held the post of vice-chairman of that organization's Diesel Engine Activity Committee. To·

NO PHOSPHATE SCARCITY EXISTS

When purchased in the form of

PHOSCALOID

Because, the phosphates in PHOS-ÇALOID are liquid products of an acid process and as such have no application in warfare.

On the other hand, Phosphorous Oxide, from which a high percentage of our commercial sodas are made, is the dry product of both the electric and blast furnaces and as such is needed for smoke screens, tracer bullets, incendiary bombs, etc. Commandeering Phosphorous Oxides, with the resulting shortage in all commercial soda phosphates, was both necessary and unavoidable by the Government.

The substitution of PHOSCALOID for this shortage—

Makes Phosphates available at no more cost;

Supplies a product that reacts with soda ash and caustic soda in the formation of any one soda phosphate or combination of phosphates;

Includes a highly effective colloid for eliminating boiler silica problems;

Allows for the direct feed of Phosphates into the lines and pumps without causing troublesome formations;

Requires less phosphates per unit volume of water treated;

The story of SILICA vs PHOSCALOID will be sent on request.

CYRUS WM. RICE & COMPANY

WATER CHEMISTS & ENGINEERS

PITTSBURGH

PENNA.

CWR

In a hurry with tube cleaning? Put Lagonda-Liberty tube cleaners on the job, and watch them race right through like the midnight express, with no stops until the end of the line.

These powerful, speedy, enduring cleaners jump right into the toughest scale deposit, chip it off, blow it out, and leave behind them clean, quick-steaming tubes.

The 1941 version of Lagonda-Liberty cleaner is a symbol of forty years of progress. It is faster, cleaner-cutting, more powerful, more enduring. Types for every tube that can be cleaned. Operators like them — say they are easy to handle.

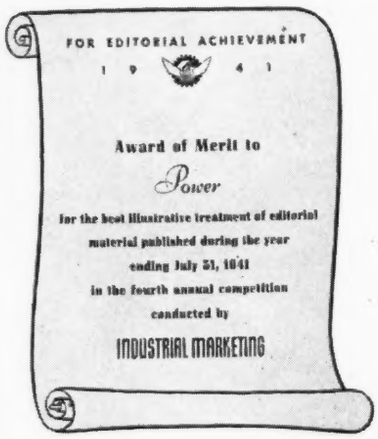
Write for the complete story.

ELLIOTT COMPANY
Lagonda-Liberty Tube Cleaner Dept.
SPRINGFIELD, OHIO
District Offices in Principal Cities

Y-176

LAGONDA LIBERTY TUBE CLEANERS

engineers attending meetings concerned with the internal-combustion engine, he was widely known for his dry wit and for his skill in debate and practical mathematics.


FOR EDITORIAL ACHIEVEMENT
1 9 4 1
Award of Merit to
Power
for the best illustrative treatment of editorial material published during the year ending July 31, 1941 in the fourth annual competition conducted by
INDUSTRIAL MARKETING

POWER Wins Award for Editorial Excellence

For excellence in illustrative technique, POWER won an award of merit in the annual editorial competition sponsored by *Industrial Marketing*. The award was announced at the annual meeting of the National Industrial Advertisers Association, held Sept 17-19 in Toronto, Canada.

The competition was established four years ago to encourage business-paper editors and to recognize the vast amount of outstanding work they are doing. In this year's contest, 101 publications submitted a total of 311 entries in five different classifications.

One first award and two awards of merit were made in each classification. POWER received its award of merit in Classification 3 for general excellence of illustration and specifically for the Special Section "Oil & Gas Power—1941", published in June of this year.

John A Roebling's Sons Co Celebrates Centenary

Founded in 1841 by John A Roebling, John A Roebling's Sons Co, Trenton, N. J., celebrated its 100th anniversary on September 19. Nearly 100 editors and publishers of industrial and business publications travelled to Trenton for the event. The visitors toured the Roebling plants and research laboratories at Trenton and at the nearby industrial city of Roebling, all heavily en-

CLEANING COMPRESSED AIR

W-K-M "MASTER" SCRUBBERS REPEAT

ON COMPRESSED AIR IN A LARGE STEEL PLANT MAKING SHELLS AND BOMB CASINGS

BRADSHAW & CO., 530 Fourth Ave., Pittsburgh, Pa.

Gentlemen: Without obligation, you may send me the bulletin fully describing the W.K.M. Master Scrubber, for:

___STEAM ___AIR ___GAS

Name _____ Company _____ Address _____ City _____ State _____

PLEASE PRINT

14

★ THERE'S A BELMONT PACKING FOR EVERY SERVICE ★

For STEAM

The defense program demands uninterrupted service of power plant equipment. Engines and pumps *must* be kept operating at maximum capacity, sometimes twenty-four hours a day—no time for frequent packing replacements.

Here are offered two standard Belmont Packings that *will* withstand the strain—Belmont 30 for reciprocating steam rods and Belmont 754-P for rotating steam shafts. TRY THEM NOW!

Write on your company letterhead for Belmont Catalog No. 40 which describes Belmont Packings for all services—a text book guide on applications. An authorized Belmont distributor will be glad to show you samples and help you with *your* particular requirements.

BELMONT PACKINGS

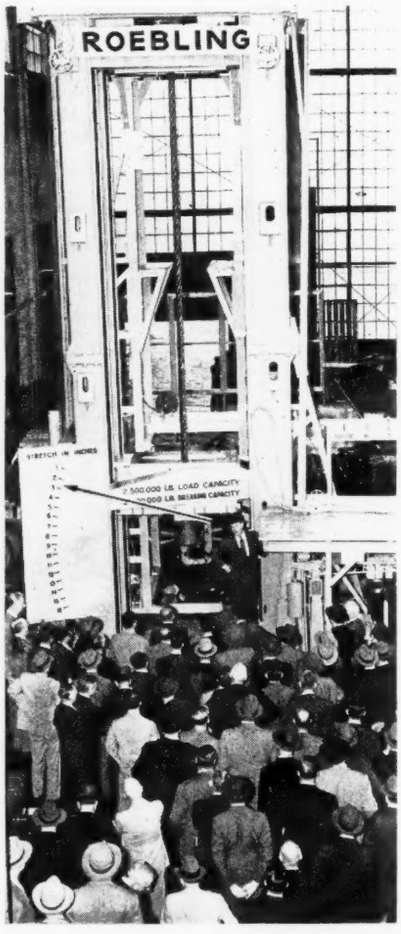
THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

FOR RECIPROCATING STEAM RODS
BELMONT 30
For reciprocating steam rods where boiler pressure is in excess of 100 pounds, (340 degrees F.)
FOR ROTATING SHAFTS
BELMONT 754-P
Practical and reliable for rotating shafts, all temperatures.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA.

gaged in producing wire rope and other wire products for defense.

In the wire and rope mills the visitors were given an opportunity to inspect and see in operation an almost endless variety of wire and rope-making machinery. One of these machines for making rope up to 5 in. in diameter is the largest in the world. An order for 4-in. rope for a 35-cu yd stripper shovel



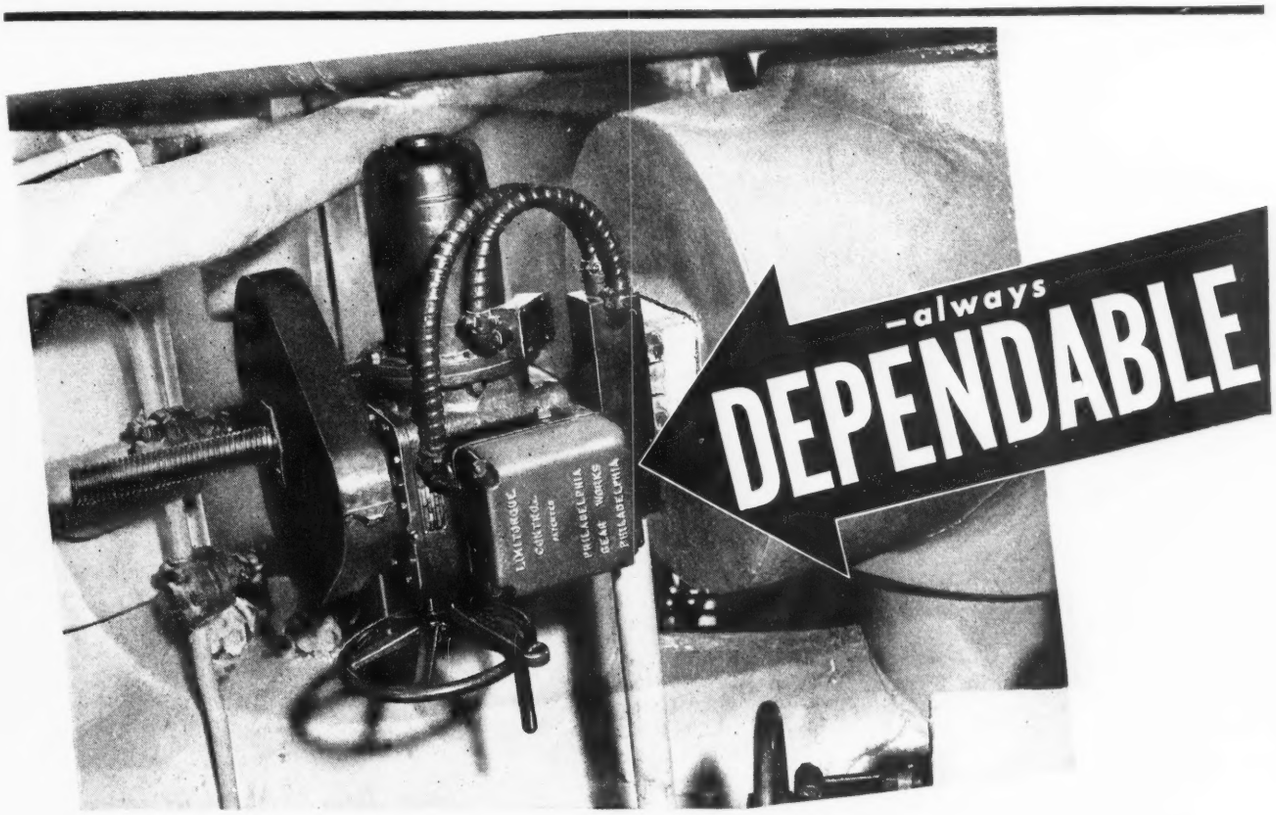
had been completed just prior to the inspection trip. As a climax to the trip, a section of this rope, as shown in the photo, was tested to destruction, and broke at a load of 1,600,000 lb. The testing machine used for this work is one of the largest in the world, having a capacity of 2,500,000 lb.

After the inspection trip, officers of the company and Leon Henderson, Head of the Office of Price Administration and Civilian Supply, addressed the editors and other guests at a special dinner.

Founder John A Roebling, German graduate of the University of Berlin and the Berlin Polytechnic Institute, organized a group of young people in 1831 to emigrate to the United States. Near Pittsburgh they established a village first called Germania and later known as Saxonburg. John A Roebling, working with crude equipment in the mead-

Philadelphia

LIMITORQUE VALVE CONTROLS

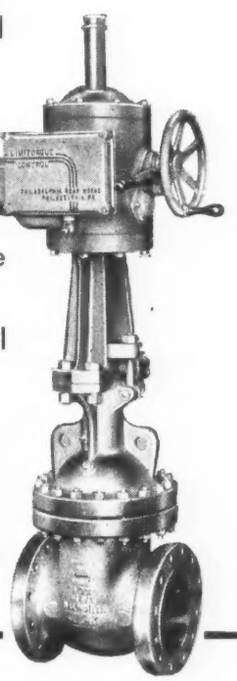


. . . for normal plant operation and/or safety and emergency service

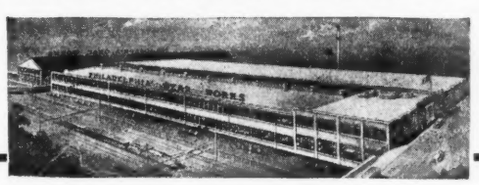
Limitorque valve operators have been designed and constructed to assure proper functioning under any and all conditions that may be encountered in central station operation. This has been proven by the experience of plants located in all parts of the country . . . from the Atlantic coast to the Pacific. When you push the button on a Limitorque Control Station it can be with absolute confidence the valve will open or close as desired.

Furthermore, with Limitorque Controls installed on any make of valve from 3" to 96" diameter, valves can be operated from a few strategic points under the attention of responsible operators. Present equipment can be fitted with Limitorque Controls.

Limitorque offers *many* advantages that are described in literature that we'll gladly send on request.



PHILADELPHIA GEAR WORKS

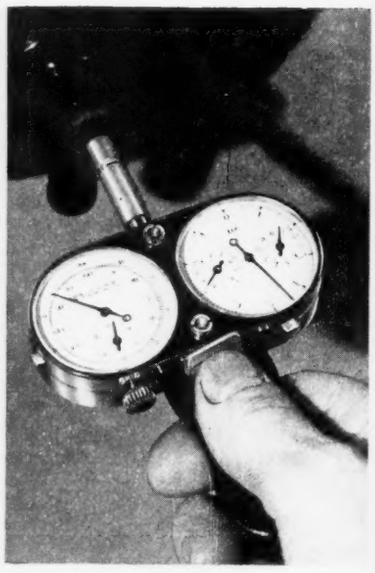


LIMITORQUE DIVISION

Erie Ave. and G St., Philadelphia, Pa.

New York Chicago Pittsburgh

"JAGABI" HAND TACHOSCOPE



For Precise Measurements of Speed

THE Tachoscope will win your confidence immediately, because it uses the well-known "speed counter" and stop-watch method, but completely eliminates inaccuracies at starting and stopping. Its precision depends only on the lasting accuracy of a high grade watch mechanism. Giving you the exact number of revolutions in the exact time in which they were made, you *know* you are right! Good for all speeds up to 20000 r.p.m. and 10,000 feet per minute. A truly accurate and dependable instrument for many kinds of speed measurement.

For showing fluctuations in speed, we recommend our Jagabi Types A and C direct-reading Hand Tachometers.

Write for Bulletin 1505-P, which describes an attractive variety of speed-measuring instruments.

JAMES G. BIDDLE CO.

ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

ows behind his farm, built a 1½-in. wire rope to replace 9-in. hemp cables used to haul canal boats over the mountains.

As a student in Germany he had thought much of suspension bridges. His first opportunity came in 1844 when he built a suspension aqueduct across the Allegheny River. In 1847 he built the wire-rope suspension bridge across the Monongahela River in Pittsburgh; in 1850 a sensational railroad bridge across the Niagara River gorge. He set up a wire-rope factory in Trenton, N. J., in 1848 and in 1860, in cooperation with the Otis Brothers, designed wire rope suitable for elevators. The Brooklyn Bridge, greatest monument to John A Roebling, was started by the designer, but he was injured and died during its construction. His son, Col Washington Roebling, took over the work. He, too, finally became ill and directed the bridge building from a sick bed, watching construction through a telescope. He spent the last four months of his life dictating to his wife every detail of the finishing of the bridge. He did not live to see the bridge open.

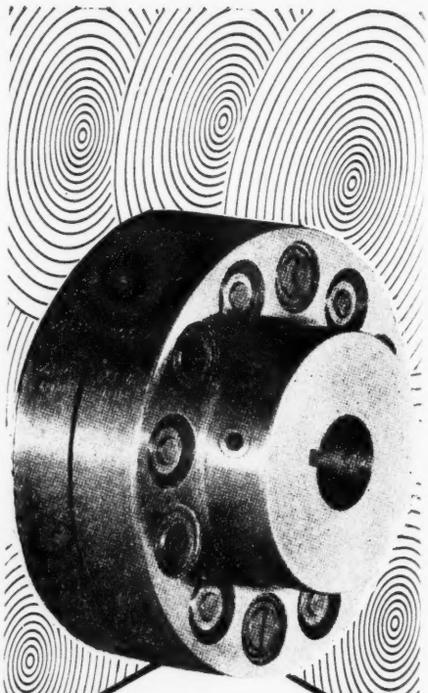
Since then the business has grown under the grandsons and great grandsons of the founder. The company entered the field of electrical conductors in the early '70s. Today connected with the general management of the company are the three great grandsons of John A Roebling: Joseph Metcalf Roebling, 1st vice president; Ferdinand William, 3rd, second vice president; Charles Roebling Tyson, secretary and treasurer.

Products include electrical conductors of all types, iron and steel rope of all types, copper and brass ropes, iron and steel wire, and woven-wire fabrics.

GE Demonstrates Million-Volt X-Rays

A news story on page 122 of August POWER pictured the million-volt x-ray machine General Electric has developed for industrial use. Such units had been installed in the plants of Combustion Engineering Co. and Babcock & Wilcox Co. for the inspection of welds in boiler drums.

On October 7 General Electric assembled 40 technical editors in Schenectady to study the million-volt machine and its applications. Dr E E Charlton and W F Westendorp of the G E Research Laboratory described the construction of the x-ray equipment. C D Moriarity of the Schenectady Works Laboratory explained the



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This is no time for shutdowns! Safeguard your production with Ajax Flexible Couplings! Their exclusive, rubber bushed, bronze bearings combine positive drive, resilient protection against misalignment, free end float, no lubrication problem, no noise, no backlash. Sizes from ½ inch bore up. Write for catalog.

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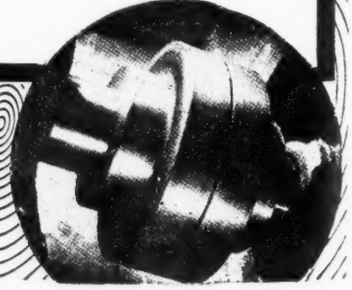

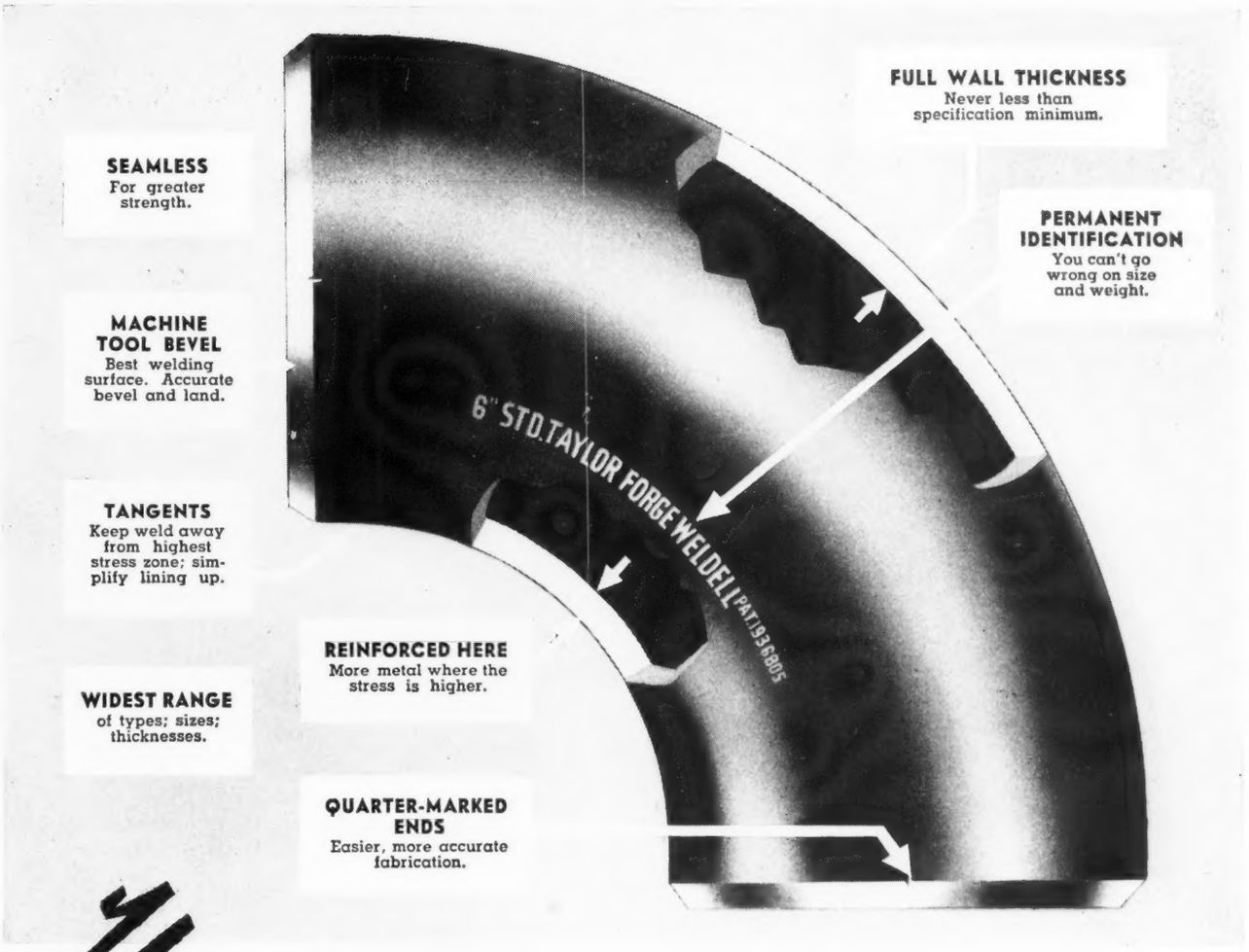
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of types; sizes; thicknesses.
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Easier, more accurate fabrication.
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"PEOPLE don't buy *names* today", comments a business publication, "they buy *products*". And that suits us perfectly as a basis for judging the merits of WeldELLS and other Taylor Forge Welding Fittings.

As for a name, none is more distinguished in the field than Taylor Forge. But we expect our products to stand on their own merits.

That's why we invite your comparison of WeldELLS, point by point, with any other make of welding fittings—why we say, as we have said in effect many times before: Consider the product—consider the features—the *eight extra-value* features illustrated here that are combined only in WeldELLS.

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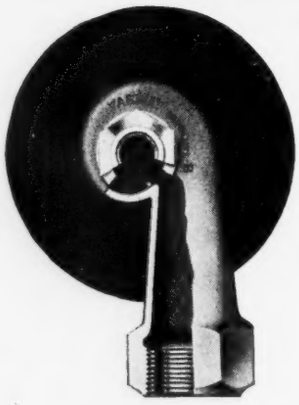

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No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from 1/4 in. to 2 1/2 in. Write for Catalog N-615.

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100 Mermaid Ave. Philadelphia

application of the million-volt x-rays to the examination of large castings. O R Carpenter of Babcock & Wilcox and A J Moses of Combustion Engineering showed how million-volt x-rays are used to detect flaws in the welded seams of boiler drums and pressure vessels. Other speakers were Donald McCutcheon of Ford Motor Company and E W Page of the G E X-Ray Corp.

As inspected by the editors at Schenectady, the newest model of the million-volt x-ray unit is insulated with Freon gas, weighs 1500 lb and is mounted for easy handling. The x-ray tube has twelve sections, building up the million-volts in steps of 84,000 volts each. Most powerful previous industrial machines were 400,000 volts, but the gain is far greater than would appear from the voltage ratio. For example, the million-volt x-ray will radiograph flaws in 5 in. steel in 2 min. With the 400,000-volt machine the same thickness of steel required a 3½ hr exposure and shows much less detail. The power required to operate the new industrial x-ray outfit at 1,000,000 volts and 3 milliamperes is approximately 4 kilowatts.

Housed in a structure with heavy concrete walls, the unit is never operated with anyone in the room. After settings are made the room is emptied of personnel, the heavy doors bolted, and the exposure made by remote control.

Statistical Utility Yardstick

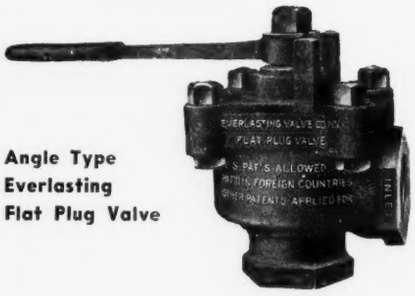
Statistical yardsticks of costs in the electric utility industry are presented by the Federal Power Commission in a 120-page report entitled "Electric Utility Cost Units and Ratios."

The report, which is the first ever devoted to comprehensive analyses of electric utility costs, is based on information obtained during a study instituted in 1938 of 393 large companies, comprising on the basis of assets or revenues, more than 95 percent of the nation's a privately owned electric light and power industry.

While information presented in the volume permits relatively detailed comparisons of costs of individual utilities with costs of other companies operating under generally similar conditions, these are not presented as absolute standards. Nevertheless, where cost items of a utility are found to be higher than the average for the industry, factual investigation should reveal the reasons for the higher costs and deter-

Why the
EVERLASTING
FLATPLUG Valve

is ideal for many throttling services



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Everlasting
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1. LASTINGLY TIGHT
Remains dependably tight through long years of service and frequent operation

2. TIME-SAVING
Provides quick opening and quick closing with a quarter turn of the handle

3. WITHSTANDS ABUSE
The faces cannot be jammed by the operator; cannot be shut too tight

4. ADAPTABILITY
Suitable for use with air, gasoline, oils, syrups, steam, water, and other fluids

5. EASILY REPAIRED
Valve Seat lifted out with the fingers; renewal of all working parts can be made in 5 minutes.

Made in straight line and angle types with iron body or special metals in all sizes from ½-in. to 4-in. for pressures up to 175 lb.

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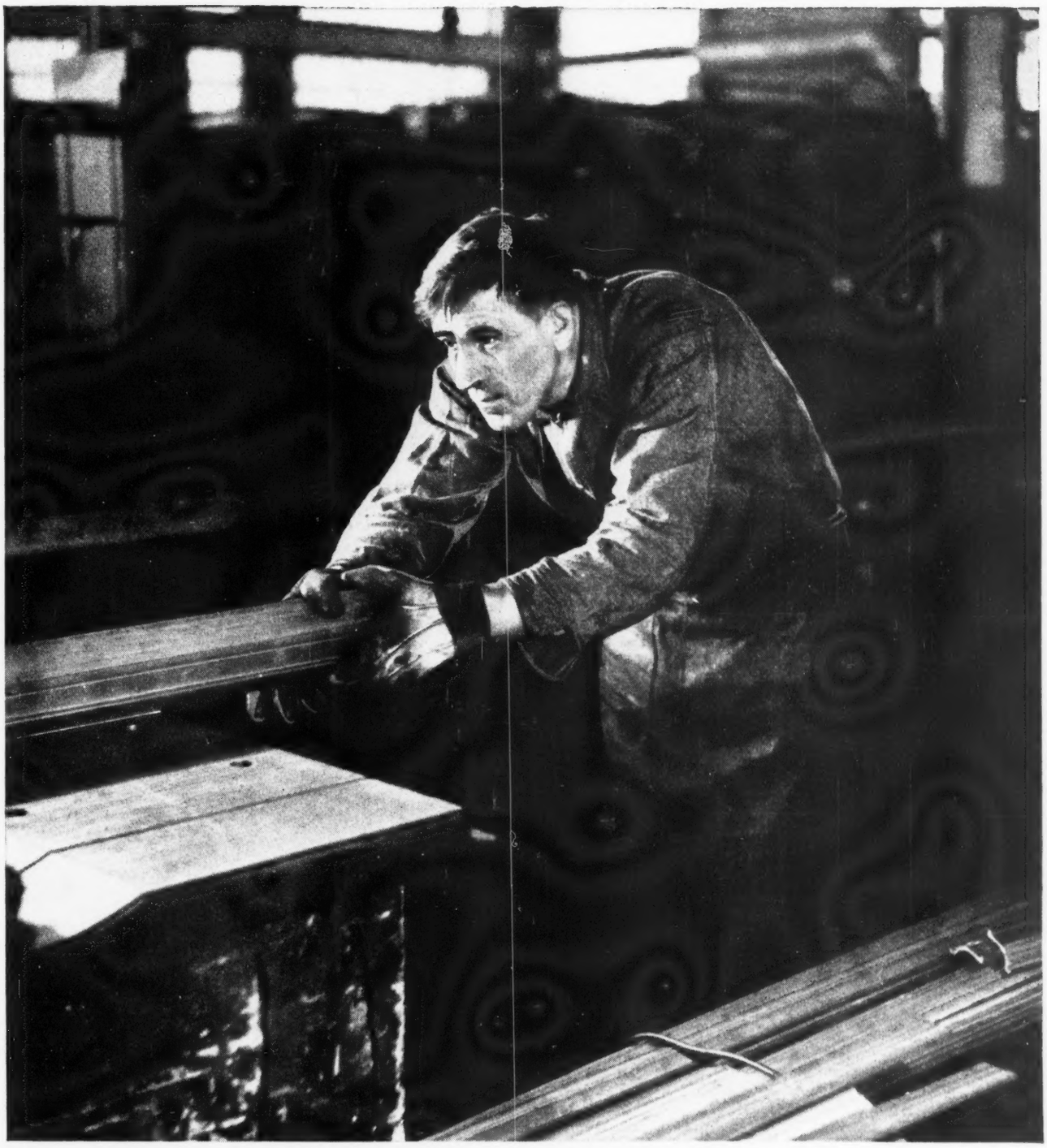
Everlasting Valves
for everlasting protection



A TRUE EYE FOR BRASS. In every department at Revere Copper and Brass Incorporated you will find men who have a "knack" for brass. Men like Peter Gura, for instance, who has been with Revere for thirty-five years—a man whose eye can tell to a hair when a brass shape is out of true, and who can set it straight as a plumb line with a practiced twist of his hands. In operations such as this, which would baffle a machine, Revere sees an opportunity to put an extra ingredient—the *human touch*—into copper and copper-base alloys. That is one of the many reasons why Revere materials are so trustworthy in strengthening America's defense, and why the end of the emergency will find Revere so well prepared for the advancing needs of industry. Revere Copper and Brass Incorporated, 230 Park Avenue, New York.

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Does internal combustion engine exhaust or steam blow-off roar spoil your good neighbor policy? Are neighbors bothered by your plant noises—especially during night-shift hours when the outside noise level is low?

Good neighbor - relations demand that you keep noise at a minimum, and Maxim Silencers will solve the engine exhaust and compressor intake noise problem. You can buy just the amount of silencing your neighborhood requires — no more, no less — because there are more than 550 Maxim sizes and models to choose from.

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mine whether conditions tending to produce excess costs may be modified or eliminated, the report says.

The report was prepared in line with the purpose of the Commission to direct its statistical activities increasingly toward the development of yardsticks of costs, rate, and performance, thereby introducing something analagous to the force of competition in an industry which has always considered itself a natural monopoly.

Part I of the report presents the results of a series of studies of electric utility plant investment. It is divided into sections on production plant investment, transmission plant investment, distribution plant investment and general plant investment

Units of Investment

Units of investment are determined in each of these classes of electric utility plant on the basis of the relationships between investment and size and type of facilities and nature of operations.

Part II presents the relationship between principal elements of operating expense and conditions of operation such as kind of transmission lines or number of customers per mile of distribution line. Average expense units are derived which reflect the influence of such operation conditions. Separate sections are devoted to each major class of operating expenses.

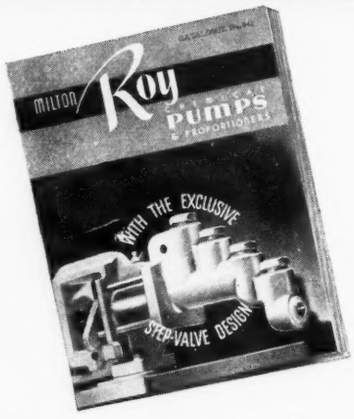
Operating Ratios

Part III is devoted to an examination of operating ratios, including maintenance operating and depreciation expenses and taxes, to operating revenues. Where appropriate, relationships between expenses and plant investment are also presented. Utilities which generate by fuel, by hydro, or which purchase the principal part of their power from other sources, are treated separately.

Part IV deals with the financial structures of utilities and items of income or income deductions as they the related to the market price of securities. Among the relationships presented are those of long term debt to total liabilities and other credits. This study is supplemented by the presentation of an average quantitative determination of the effect of high or low proportions of debt on relative interest charges.

The report, designated FPC S 18, is bound in blue cloth and is sold by the Federal Power Commission, Washington, D. C. to which all requests should be addressed.

MILTON Roy PUMPS



New Catalog

Contains simplified selection chart to help you choose the right pump; illustrates complete sulfite feed system to boilers; how to feed chemicals directly into boilers; shows typical installations.

This catalog fully describes the exclusive Milton Roy double-ball-check step-valve design, how it prevents air-binding and minimizes wire-drawing, why it is self-cleaning and non-clogging.

It describes an improved method for adjusting piston stroke (while running) to accurately control pump capacity; also a new single cover-plate design that makes the entire interior of the valve quickly accessible without disturbing pipe connections. It lists chemicals handled by these pumps.

You'll find all the above and other information of real value in this catalog . . . plus illustrations, specifications and details of standard Milton Roy Simplex and Duplex pumps, also Opposed-end and Quadruplex pumps built to meet special requirements.

If you need pumps for boiler-water treatments, or for accurately proportioning other chemicals, it will pay you to write for Catalog No. 941.

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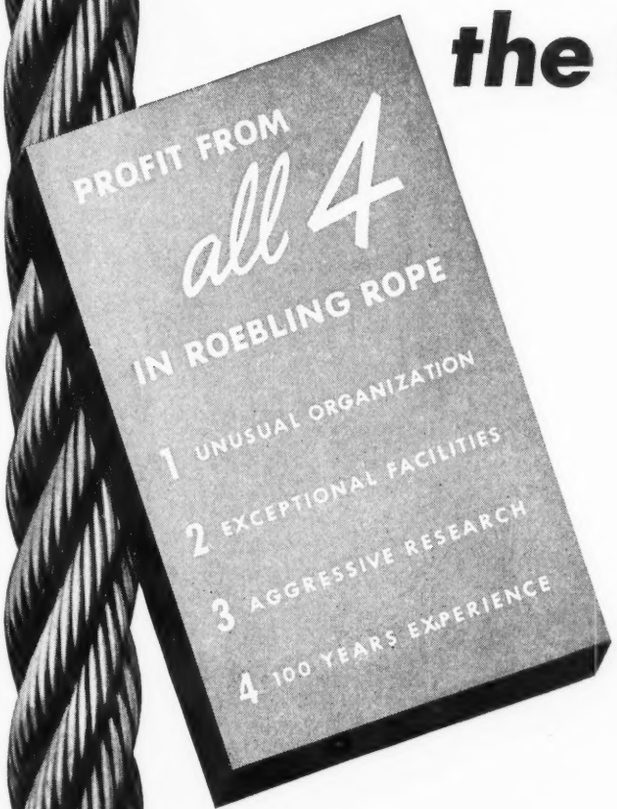
We can still make prompt shipments of a number of standard size Milton Roy Pumps. Write or wire your requirements.

MILTON ROY PUMPS
1362 E. Mermaid Ave., Chestnut Hill, Phila., Pa.

Chemical Feeders and Proportioners

DON'T DEPEND ON LUCK!

Be Sure with the ROEBLING "4"



The "Roebling 4" take guess-work out of wire rope performance.

We back up Roebling "Traction Steel" Elevator Rope with this definite claim:—Roebling "Traction Steel" will give you unexcelled *over-all* rope service—service that will assure you of maximum safety and minimum *general-average* rope operating cost.

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LEAVING NOTHING TO CHANCE!

In the Roebling testing laboratories we make certain that not even a single wire in a reel of Roebling Wire Rope is an unknown quantity.

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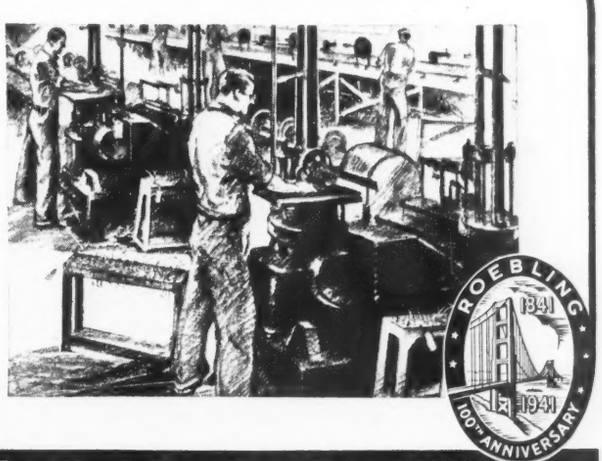
In Roebling "Traction Steel" you get predetermined quality, known stamina, safety—of the highest degree.



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In more than
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COCHRANE
MULTIPORT
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Cochrane Multiport Back Pressure Relief Valve with front and back plates removed.

Successful operation of the Cochrane Multiport Valve in more than 12,000 plants is a sure guarantee of its continuously reliable operation. This continuous operation is insured by the multiport principle — a number of small discs instead of one large disc, eliminating the sticking, jamming and freezing common to single-disc valves in the control of atmospheric relief, back pressure, etc.

Call your Cochrane representative or write for further details.

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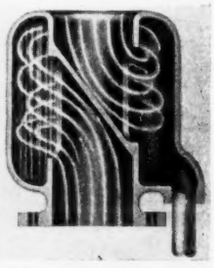

Designed to separate condensate and oil from steam discharged to atmosphere and thereby prevent raining of water and oily condensate on the roof, Cochrane Exhaust Heads incorporate a highly efficient free-flowing baffle type construction and an exceptionally large port area which minimizes back pressure. Write for further details.

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Please send me complete information on Cochrane Multiport Relief Valve and Cochrane Exhaust Head.
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Power Generation Emphasized at AIEE Covention

A diversified program of seven technical sessions, one general session, two conferences, various trips, sports and entertainment occupied the attention of members and guests at the American Institute of Electrical Engineers, Southwest District meeting, held October 8 to 10, at the Coronado Hotel, St. Louis, Mo. Thursday morning's session, sponsored by the Electric-Machinery and Power-Generation Committees, had for its first paper a description of the Venice plant No. 2 of the Union Electric Co of Illinois, by R R Wysner and Stanley Stokes.

Venice Station No. 2

This station is designed on the unit basis and is fundamentally conceived as consisting of 80,000-kw units, of which the first is split into two 40,000-kw sections for operating convenience. Each 40,000-kw machine is a complete power plant with a 360,000-lb per hr boiler, feed-water heaters, feed pumps and all auxiliaries. Two 40,000-kw and one 80,000-kw unit are now being installed. The 80,000-kw unit will have two 370,000-lb per hr boilers, but the two boilers will be operated as a unit and pumps, heaters and all other auxiliaries are on a strictly unit basis.

Steam is supplied to the turbine throttle at 850 lb 900 F. Selection of steam conditions was the result of balancing capital costs, which are high at the present time, against fuel costs, which are comparatively low in this part of Illinois. The same considerations governed the selection and arrangement of all mechanical equipment.

Boilers for the first section were supplied by Combustion Engineering Co. Each boiler has three pulverizers, each of which supplies two burners. The six burners are all located in the front furnace wall and are of the horizontal turbulent type. One of the three mills and its pair of burners is designed for light-load boiler operation. Air for combustion is preheated in Ljungstrom heaters and draft is supplied by combination forced- and induced-draft fans, two for each boiler. The second section boilers are being built by Riley Stoker Corp. Each will have three pulverizers and six burners of equal capacity. These boilers have tubular air heaters, otherwise the boiler auxiliaries will be the same type as those in the first section.

Coal is delivered from cars to a track hopper, conveyed to a Bradford breaker, and then on a long incline conveyor to

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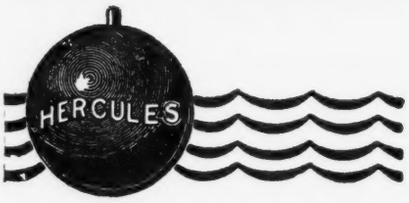
Seamless Copper
FLOATS



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Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

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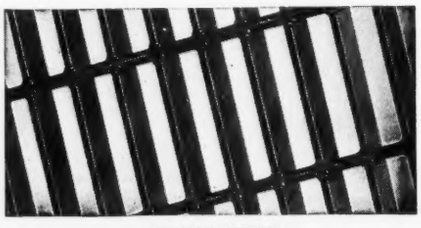
When you need grates
Specify **BATES**
FOR LONG-TIME ECONOMY



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BATESGRATES
—One Piece Construction

Each intersection, and consequently, each complete panel of Batesgrates, is strictly one piece. Non-slip, sharp top edge, self cleaning cross bars like the ridge of a roof. No cracks, joints, or acute angles. No grooves to hold grease and dirt and create slippery spots. Batesgrates are an engineered assembly of bars—all bars work.

Write for engineering Catalog No. 937.

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–keep them turning with the oil that prevents rust

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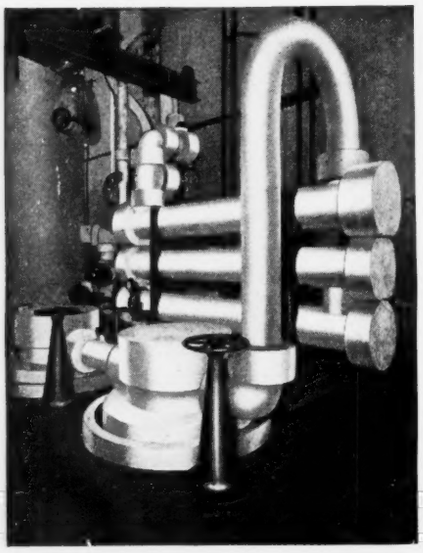
Does your turbine oil meet *all 3* vital requirements of modern turbine lubrication?

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

The new Shell Turbo Oil does. That's why it has made such a hit with turbine operators.

Find out more about this sensational *new* turbine oil. The use of Shell Turbo Oil assures you of the continued watchfulness of Shell men —a service which needs no prompting. Call in the Shell man today. *Let him give you the facts!*

Your production is measured by your boiler's ability to produce plenty of clean steam in an uninterrupted flow!



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CONTINUOUS BLOWDOWN

- **INCREASES BOILER CAPACITY**

  A clean boiler means an efficient boiler. Henszey Continuous Blowdown prevents priming, foaming and other troubles caused by high boiler water concentration, and with simple water treatment keeps the boiler free of scale.

- **INSURES CLEAN STEAM**

  By holding the boiler water concentration below a "safe" point the Henszey Continuous Blowdown System prevents carryover. Clean steam means less wear on equipment—cleaner tubes—less steam consumption.

- **INSURES UNINTERRUPTED FLOW**

  With boiler water concentration held below the proper degree boiler repairs and shutdowns are held at a minimum. Equipment lasts longer—valves, traps, etc., function perfectly.

We will be pleased to send you our folder "Complete Automatic Control of Boiler Water Concentration without Heat Loss". Send for your copy.

HENSZEY COMPANY

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HENSZEY

the bunkers. The use of an incline belt of suitable slope was made possible by the unusual arrangement, which places the boiler-house toward the river and away from the point at which coal is delivered. Every effort has been made to avoid dust nuisance in handling coal. The coal dumper is totally inclosed and a suction system removes dust from the building, and also from the breaker-house and each transfer point in the coal-handling system. The bunkers are sealed at the trippers and all dust collected is returned to the bunkers. The coal is sampled continuously for analysis as delivered to the bunker.

Cottrell precipitators are provided for each boiler. Dust from the precipitators is delivered to a silo north of the station by a suction conveyor, while a sluicing system conveys the ashes from the furnace bottom to a sump.

Control System

A very complete system of instrumentation and control has been provided for all mechanical equipment. From boards located in the turbine room basement the operator observes and controls all details of the circulating-water and feedwater systems. From the boiler-room operating board adjacent to the coal feeders the operators observe all details of the feedwater system and combustion apparatus, the latter being normally under automatic control. From the same board, the operators can control combustion manually and can take over the control of the feedwater supply system in an emergency.

The first two 40,000-kw turbo-generator units supplied by Allis-Chalmers Mfg Co will be controlled by either of two independent operating governors, both of which will be of the relay or actuator type. One of them will be a standard relay type, speed-responsive governor, with a fixed regulation of about 4%, and will have an adjustable load limit. The other governor will be a so-called supersensitive speed-responsive one with adjustable regulation, speed compensation, load and load-limit indication and adjustment. This latter governor is designed for a sensitivity of 0.01 of 1% and is being manufactured by the Woodward Governor Co.

Turbine-speed regulation will be arranged so that either governor can control the unit through a common regulating valve and hydraulic cylinder. Change from one governor to the other, or from one adjustment to another, can be easily made while the unit is in operation, so as to observe their effect on system-speed variation. This ar-

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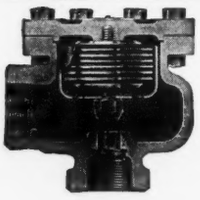

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NON-FREEZING - HIGH CAPACITY INDUSTRIAL STEAM TRAPS

Cannot freeze (can be placed right out in the weather); is never water-logged; cannot air-bind; intermittent discharge; largest water and air discharging capacity of any trap on the market; same size valve is used on vacuum as at 200 lbs.; moderate in price. "Nicholson" Industrial Trap Bulletin No. 439 on request. Sent on trial.

ALSO:—Nicholson Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

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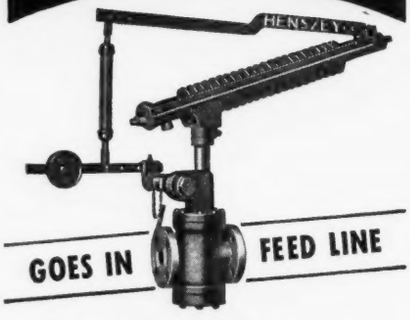
HENSZEY
BOILER FEED REGULATORS



The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order — nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
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PRESCRIPTION *for prolonging life*

Every steam boiler has its individual span of life . . . so many years of active service before it wears out and must be replaced.

Its purchase price, divided by the number of years you can use it, represents the annual cost of a boiler's life in actual cash.

A boiler's existence may be shortened directly by corrosion, embrittlement or the repeated removal of scale by mechanical means.

These adverse conditions can be avoided through Bird-Archer's scientific treatment of the boiler water which greatly prolongs the earning power and reduces the annual cost of a boiler's life.

Have you a copy of this useful handbook on types of water, situations, treatments? We'll be glad to send you one—without cost, of course. Simply write for "Boiler Water Treatment."

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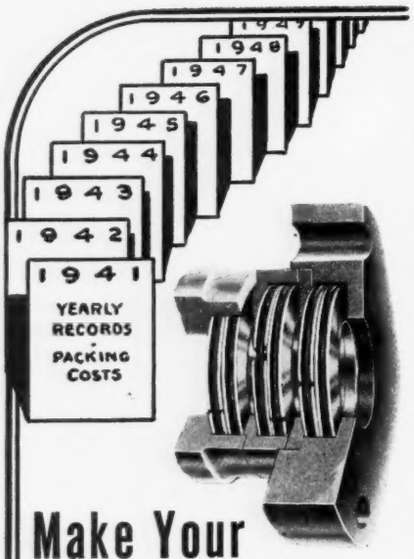


Make Your Next Packing Job L-A-S-T!

During these days of increased production and time-limiting schedules, it is especially annoying and costly to experience shutdowns due to packing trouble.

There is a solution. Install France "Full-floating" Metal Packing in your engines, pumps and compressors. The result is increased efficiency.

And each job lasts for years without maintenance expense. Saves money, too, in the long run.

Installation is a simple procedure. See that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C.

Sold on approval Satisfaction Guaranteed

Write for details and Catalog M7. Make your next packing job L—A—S—T.

THE FRANCE PACKING COMPANY
Tacony, Philadelphia, Penna.

Original FRANCE METAL PACKING

rangement will provide considerable latitude in selecting the governor characteristics best suited to operating conditions on the system at any particular time. The governor system will be equipped so that the unit may be synchronized from the switchboard room at any system speed from 5% above to 10% below normal speed.

The two 40,000-kw. units for the first section will have Allis-Chalmers air-cooled generators, but the generators for the 80,000-kw turbine will be General Electric hydrogen-cooled design.

Turbine-Governor Analyzer

W O Osborn, in his paper, "A Turbine-Governor Performance Analyzer," pointed out that previous instruments used for checking turbine-governor performance have in general possessed limitations which leave their accuracy open to question or which render them inconvenient to apply in use. Ordinary graphic frequency meters, pressure recorders and recording tachometers, although entirely satisfactory for the purpose for which they were intended, do not respond rapidly enough to measure accurately the characteristics of the modern-turbine governor.

Coordinated Instruments

In many instances instruments for measuring certain essential qualities, particularly valve travel and hydraulic pressures, have been more or less makeshifts, making their application to the turbine and the taking of simultaneous observations a difficult and irksome undertaking. In his paper, Mr Osborn describes a completely coordinated set of recording instruments which have been especially designed for analyzing the performance characteristics of steam-turbine governors. These instruments are characterized by their wide range of measurement, their sensitivity, and by their ability to follow changes many times more rapid than can be followed by usual recording instruments capable of measuring similar quantities.

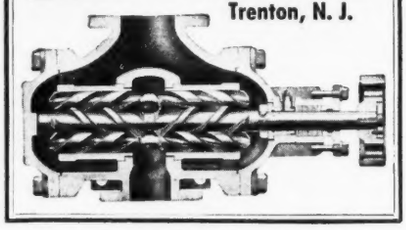
It has been demonstrated in several applications of the new turbine-governor performance analyzer to actual field tests that a minimum of time and effort is expended in both preparation for and during the test. Furthermore, the information obtained is complete and easily interpreted by anyone familiar with governor characteristics. The instruments themselves are rugged and foolproof and can withstand considerable abuse. When not in use, and during transit, they are contained in five rugged carrying cases, which improves portability of the equipment.

of the De Laval-IMO Oil Pump are the power and idler rotors, which run in perfect rotational and hydraulic balance. The pump, therefore, operates at standard motor and turbine speeds without vibration. Delivery is uniform and without pulsation, as from a steadily advancing piston. The IMO pump handles any volume of any oil against any pressure.

Ask for Catalog I-85.

IMO MOVE OIL

IMO PUMP DIVISION of the DeLaval Steam Turbine Co. Trenton, N. J.



What's NEW? THIS IS!

The new Model WTI Iron Body—Bronze Trim Relief Valve . . . Lonergan designed for liquid service requiring medium capacity.

Few parts, simple design eliminates possibility of costly repairs and insures maximum efficiency and reliability. Springs cadmium plated to prevent corrosion and designed for best efficiency and long service life.

Ask about this; write—

J. E. LONERGAN CO.
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250= sq. inch maximum pressure. Sizes from 1½" to 6". Regularly furnished with "plain top" and flanged inlet, screwed outlet; supplied with hex cap and flanged connections when specified.

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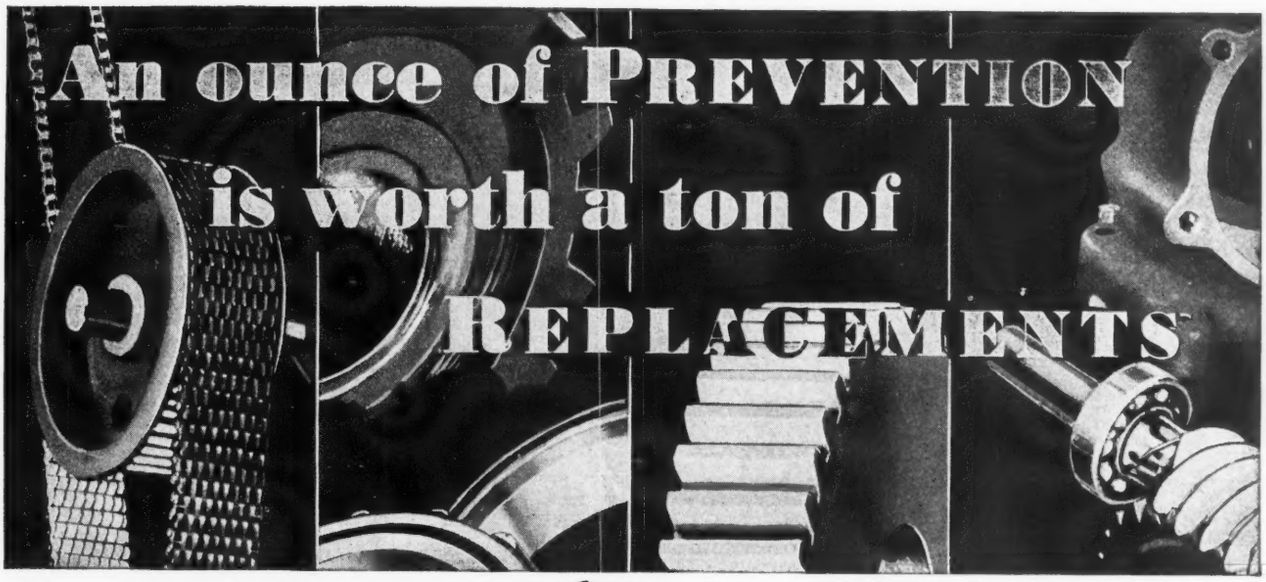
GAUGES · SPECIALTIES

300 Specialties for Power Plants • Since 1872



THE CENTERLESS GRINDING CO., INC.

Hardened and Ground Screw Machine Products • Production and Custom Grinding
Small Shafts, Spindles, Taper Pins, Small Cams Made to Specifications

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Bridgeport

October 1, 1941

Lubriplate Division
Fiske Brothers Refining Co.
129 Lockwood Street
Newark, N. J.

Gentlemen:

We wish you to know how pleased we are with your Lubriplate. We have been trying to obtain a lubricant which will retain its film but have found nothing which has proved satisfactory until we began using your Lubriplate 130-A.

Not only does this Lubriplate retain its film but, on infeed grinding on our Cincinnati Centerless grinders, it has increased production, in some instances as much as ten per cent.

We want others who are seeking this type of lubricant to know the satisfaction which your Lubriplate 130-A will give, and highly recommend it to them.

Very truly yours,

CENTERLESS GRINDING WORKS

Wm. Horberg
President

WH:MT

Defense Production

makes replacement parts such as bearings, gears, chains and other machine parts hard to get. It's your patriotic duty to conserve them.

That is why practically every type of industry is demanding more and more LUBRIPLATE Lubricants. They stop progressive wear . . . they prevent rust and corrosion . . . they conserve power.

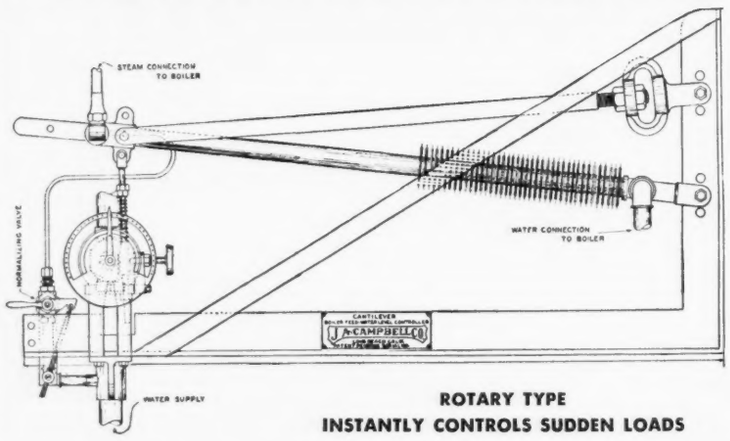
This unsolicited letter is typical of those we have received from machine manufacturers and users all over the country. If you are not yet using LUBRIPLATE get in touch with our nearest dealer today.

LUBRIPLATE DIVISION, FISKE BROTHERS REFINING CO.
NEWARK, N. J. TOLEDO, OHIO
Dealers from Coast to Coast.

LUBRIPLATE

THE MODERN LUBRICANT *that Arrests Progressive wear*

CAMPBELL CANTILEVER BOILER WATER LEVEL CONTROLLER



ROTARY TYPE
INSTANTLY CONTROLS SUDDEN LOADS

FEATURES

Sturdy Construction
Positive, Sensitive Control
Saves Fuel
Improves Steaming Capacity
No Maintenance Expense

Cantilever principle multiplies expansion and contraction in tube by six, giving wide range of movement and supersensitive operation of valve. Smaller valve can be used. Fins on lower end of tube double the temperature difference between its ends and thereby double the efficiency. Saves fuel and improves steaming capacity by maintaining uniform water level under fluctuating loads. All moving parts and fittings cadmium plated. Ask for catalog.

Some selected territories for Distributors are available

J. A. CAMPBELL CO.
649 E. Wardlow Road, Long Beach, California

HIGH PRESSURE STEAM AT LOW COST!

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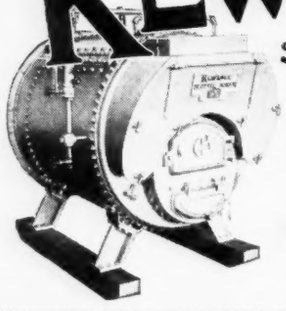

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Five sizes . . . conveniently compact, yet easily accessible . . . most economical in first and operating costs. A fuel saver. May be purchased on easy payments under FHA terms thru our Finance Corp.

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"AMBEST" *good to the last stroke on ANY good rod . . .*

The tougher the job—the more convinced you'll be that "AMBEST" is the economical, long-lived packing to use. "AMBEST" is *universal* in application because it is equally suitable for reciprocating or centrifugal rods—for engines, compressors, pumps, valve stems—for all pressures and temperatures up to 550° F.

Use "AMBEST" on *any good rod*. It's easy to apply, instructions on every can, long-lived—a safe, metallic packing that is lubricated and graphited for smooth, tight, anti friction service.

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Send for our 36 page catalog covering the "EUREKA" line of Flax, Asbestos, Rubber and Metallic Packings.

EUREKA PACKING CO., 294-296 46th St., BROOKLYN, N. Y.

It is Mr Osborn's opinion that extensive use of the new instruments will add greatly to the operative engineer's knowledge of the characteristics of the governors and show the governor designer the way to noteworthy improvements in design.

Vibration Elimination

With the advent of large sturdy 3600-rpm. turbine generators the problem of double frequency vibration became acute. Although it had been recognized for several years that 120-cycle vibration existed in machines of smaller capacity, the magnitude of this vibration was not sufficient to require special consideration. These generators were relatively small, as we know them today, and it was not until the large units were developed that corrective measures were required. Both the rotor and the stator are responsible for this double frequency vibration. In their paper, "Experimental and Operating Data on Vibration and Sound Level in Two-Pole Generators," J W Batchelor and H E Criner review the reasons for such vibration, discussed the methods used in its correction, and presented results from shop and field tests showing that the solution used reduces the 120-cycle vibration to approximately 10% of that found in machines of conventional construction.

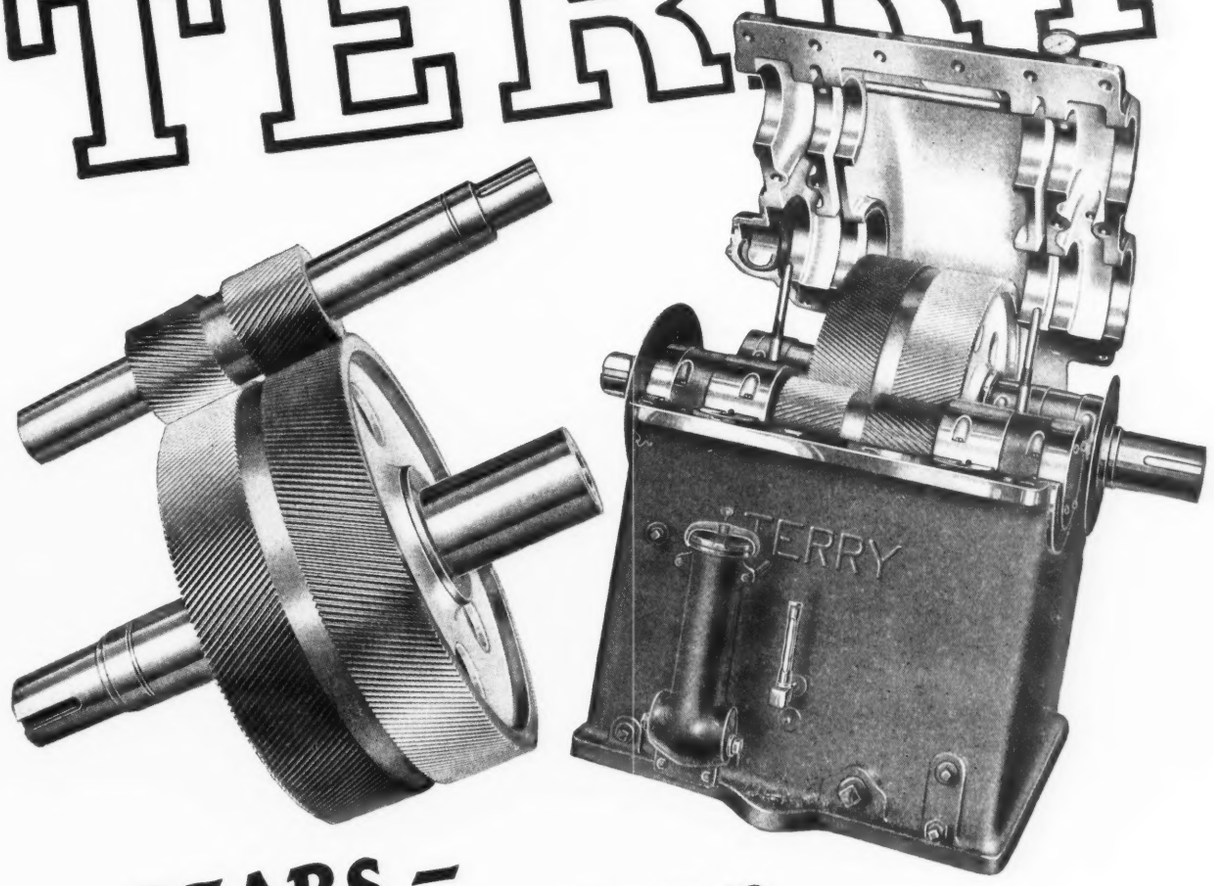
It is particularly desirable to reduce 120-cycle vibration because of the damage which may occur to foundation sections, instruments, etc. The foundation, while it is a relatively solid structure, may have certain parts which are close to resonance at 120 cycles.

Structure Design

Design of the structure so that the natural frequency is not close to the exciting frequency will remove some of the possibilities of damage by vibration, but a more fundamental attack is to reduce the magnitude of the exciting force at its origin. This has been done by a method that isolates the stator core so that mechanical energy cannot be transmitted to the foundation and a portion of the sound energy can be absorbed by the generator frame and has been done by a special method of supporting the stator core and frame.

In this system the stator core is built as a unit separate from the outer frame. The laminations are assembled in a skeleton inner frame which is made in two halves so that shims may be removed from the splits and the halves clamped tightly around the laminated core. Consequently, there can be no

TERRY



GEARS — FOR SPEED INCREASING OR SPEED REDUCING

The Terry gear has been developed to handle the high speeds and powers that are associated with steam turbine installations. It has been used successfully in thousands of plants in connection with turbines, high speed centrifugal compressors and the like.

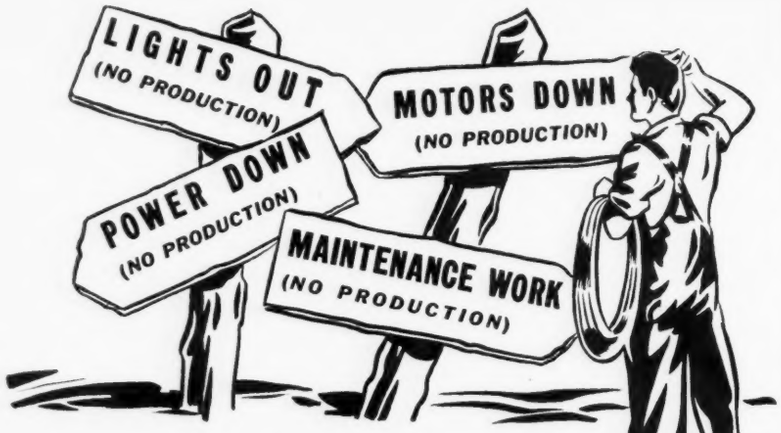
Each Terry gear is carefully engineered to suit the installation. All rotating parts are accurately balanced. Forced feed lubrication is used on the bearings and the meshing teeth. The teeth are double helical and are generated on precision gear cutting machines. The bearings are of the babbit lined sleeve type and are unusually heavy so as to prevent distortion under load.

Full details of the Terry gear are included in our bulletin S-130. A request on your business letterhead will bring a copy.

Above: Typical Terry high speed gear. Accurate fixtures and gauges insure that the boring of the case is in perfect alignment and that standard bearing shells will exactly fit and be interchangeable.

T-1145

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



Why be Perplexed?

DO SOMETHING about it!

If *your* lighting, power and control circuits are quitting on you and clogging up production, and motor lead failures are knocking out machines just when you need them most . . . *don't replace the old stuff and hope* . . . rewire with *permanently insulated Rockbestos.*

1. Rockbestos A.V.C. Boiler Room and Lighting Wire (Underwriters' and Nat. Elec. Code — Type AVA maximum operating temperature 110°C. (230°F.)

2. Rockbestos A.V.C. 600 Volt Power Cable (Underwriters' and Nat. Elec. Code — Type AVA maximum operating temperature 110°C. (230°F.)

3. Rockbestos A.V.C. 600 Volt Motor Lead Cable (Underwriters' and Nat. Elec. Code — Type AVA maximum operating temperature 110°C. (230°F.)

Right now when every ounce of production is needed, high overloads and the continuous operation of lighting, power and control circuits are building up trouble that's bound to cause annoying failures when you least expect them *and when you can least afford them.* Copper-heating temperatures and the high ambients that attack circuits close to boilers, furnaces, drying ovens, kilns, soaking pits, steam lines, etc., dry out and crack ordinary insulation and the failure which follows kicks your production out the window.

If that's your situation we suggest that you keep a wire failure chart so that you can spot your "repeaters," calculate your *minimum requirements* and rewire with Rockbestos permanently insulated wire, cable or cord.

For a catalog or samples write to: Rockbestos Products Corp., 823 Nicoll St., New Haven, Conn.

Also refer to McGraw-Hill Electrical Buyers Reference

Anticipate Your Requirements!

New York Buffalo Cleveland Detroit Chicago
Pittsburgh St. Louis Los Angeles San Francisco Portland, Ore. Seattle

Rockbestos All-Asbestos Power and Rheostat Cable — National Electrical Code Type AI — one of 118 different permanently insulated wires.

relative movement between the core and the inner frame. The stator winding is assembled and the complete stator inserted in the outer frame, after which the supporting members are installed.

The stator supports consist of a set of vertical rods between the inner and outer frame which absorb the load due to core weight and the torque reaction. The core is positioned by means of lateral rods located in a horizontal position at the bottom of the frame, and axial positioning members located in a horizontal plane at the top of the frame. The lateral and axial members are stressed only by the small radial displacement of the core. The inner frame is constructed so that all support members are attached to it at the point where tangential motion is zero. This type of construction permits the use of bars long enough to be flexible, but having sufficient cross-section to be stiff in compression.

Application of this method of stator-core mounting affects a substantial reduction in the vibration amplitude of the generator frame so that structures adjacent to the generator will have only negligible vibration amplitude at double frequency, unless they are particularly susceptible to vibration at that frequency.

FPC Announces New Statistical Survey

The Federal Power Commission announced the issuance of a new coordinated statistical service recently in which six annual publications and 24 monthly issues relating to electric power statistics are combined in one loose leaf volume.

In addition to the data that have been issued as separate publications regularly there are included in the new service monthly reports on electric power requirements and supply.

MEETINGS

American Association for the Advancement of Science—*Winter Meeting, December 29 to January 3, 1941 and 1942, Hotels Adolphus and Baker, Dallas, Texas.*

American Institute of Chemical Engineers—*34th Annual Meeting, November 3–5, Cavalier Hotel, Virginia Beach, Va.*

American Society of Mechanical Engineers—*Annual Meeting, December 1–5, 1941, Hotel Astor, N. Y. C E Davies, secretary, 29 West 39th St, New York, N. Y.*

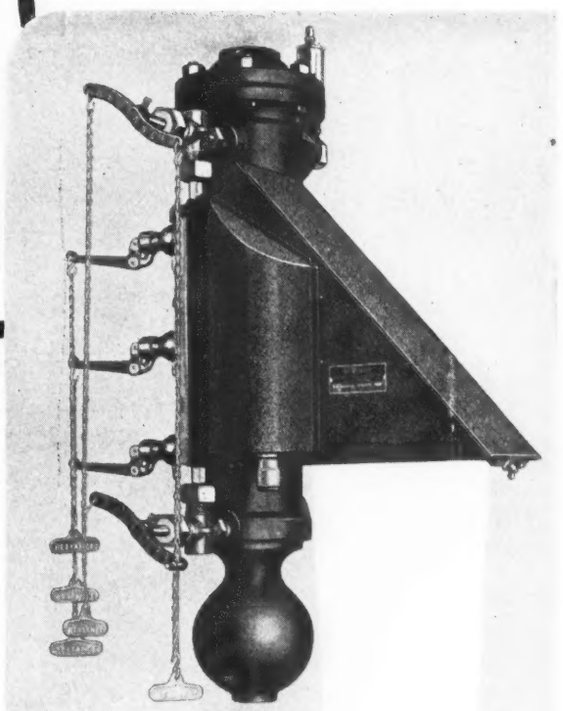
American Society of Refrigerating Engineers—*Annual Meeting, December 3–6, 1941, St. Louis, Mo.*

International Heating & Ventilating Exposition—*7th Annual Exposition, in conjunction with 48th Annual Meeting, American Society of Heating and Ventilating Engineers, Commercial Museum, Philadelphia, Pa., January 26–30, 1942.*

How the Reliance Safety Team Gives You *Double★ Supervision* of Boiler Water Levels

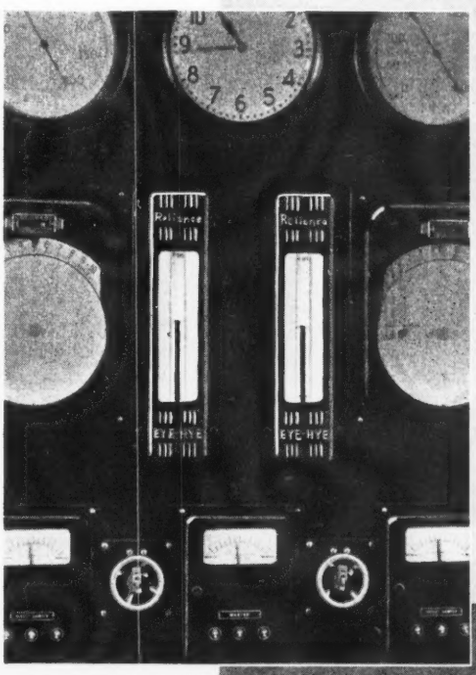
★ Reliance ALARM Water Column

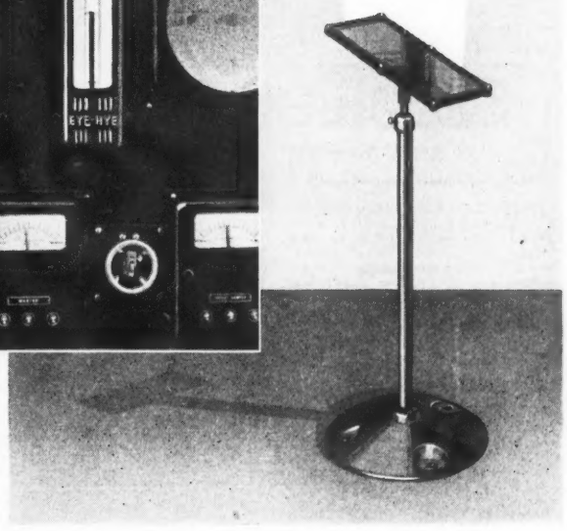
★ EYE-HYE Remote Reading Gage



PREVENT boiler outage and expensive water level accidents by having *adequate* boiler water supervision. The Reliance Safety Team — ALARM and EYE-HYE — provides accurate "double check" in a steadily increasing number of plants. Here at the Froedtert Grain and Malting Co., Milwaukee, Reliance Equipment saves operators hours of time, thousands of steps in their vital job of checking the "life blood of the boilers."

1. Reliance ALARM Water Column — standard equipment with many boiler makers, is the unfailing SOUND check, warning operators immediately by shrill whistle when water stages get too low or too high for safety and economical operation. . . .
2. EYE-HYE Remote Reading Gages on instrument panel, easily installed at almost any distance from the boilers, invite frequent reading. Operators see a bright green illuminated column of liquid that gives them an accurate SIGHT check as conveniently as any of the instruments. . . .
3. The Reliance Prismatic Gage provides a sharp black and white image that is projected by the Periscope to a mirror directly under the water column — a close-to-boiler reading for anyone passing that way. No climbing or "neck-bending" to check the column gage.





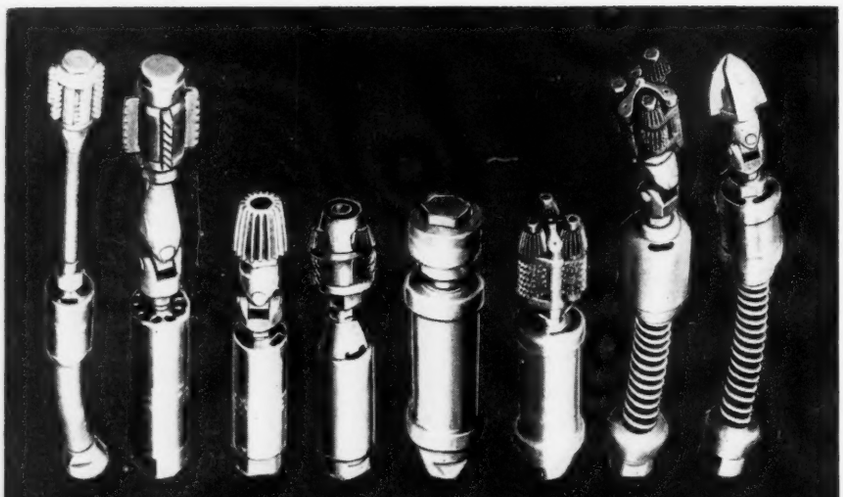
It doesn't pay you to bargain with power failure these days. Make sure of complete water level supervision with Reliance Boiler Safety Devices.

Write for catalogs and information.

The Reliance Gauge Column Co.
5902 CARNEGIE AVE., CLEVELAND, OHIO

BOILER SAFETY DEVICES since 1884

Reliance



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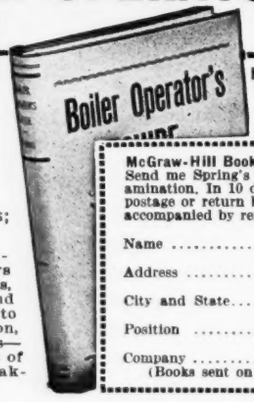
In hundreds of plants engaged in the production of defense materials—where time is precious—and in thousands of other plants which buy tube cleaners on an efficiency basis—Wilson Tube Cleaners are used exclusively. This is because Wilson Tube Cleaners clean tubes *faster, better* and *more economically* and thus save time, fuel and money and increase boiler efficiency and plant production.

Wilson tube cleaning equipment will clean any straight or curved tube—of ferrous or non-ferrous metal—of large or small diameter—*quickly, thoroughly* and *economically* because they have *extra power, extra speed* and *extra efficiency*

Send for the name of our representative nearest to you or for a copy of our thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.

THIS NEW BOILER OPERATOR'S GUIDE
. . . can mean money to you!



JUST OUT! Here's information of the most priceless sort for you — whether you want to improve your ability as an inspector or to utilize effective inspection methods in the more efficient, safer operation and upkeep of your own boilers.

Helps you meet everyday problems; Prepares you for license exams

With hundreds of typical examination questions and answers as well as complete instructions, this book presents fully and plainly the things you want to know about proper installation, operation, and care of boilers—the things that prevent dollars of loss in reduced efficiency, breakdown, or even accident.

By H. M. Spring, Jr.
353 pages, 6 x 9
241 illustrations
$3.00

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McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C.
Send me Spring's Boiler Operator's Guide for 10 days' examination. In 10 days I will send you $3.00, plus few cents postage or return book postpaid. (We pay postage on orders accompanied by remittance.)

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City and State .....
Position .....
Company ..... FP. 9-41
(Books sent on approval in U. S. and Canada only.)

These publications were recently instituted, as an essential phase of the national defense power program, to present peak demands and available capacity by power supply areas, and will be continued throughout the present national emergency.

The combined service presents detailed information on capacity and generation by electric utilities, utilization of electric energy, interstate movements of electric power, fuel consumption and fuel stocks for the generation of electric energy, and other related subjects. The statistics are presented by power supply areas, states and regions. Segregations are made by type of prime mover and class of ownership.

Subscribers to the coordinated statistical service will receive with each subscription a convenient loose leaf post binder, and tabbed separators for each section. These are designed to facilitate reference to the data, as well as to provide a convenient method of filing the monthly reports of current data.

Reports Included

The following reports are included in the new service:

Production of Electric Energy in the U. S. Published monthly for current and preceding months. Production data by states for all classes of ownership and types of prime mover. Also data by states on utilization of electric energy.

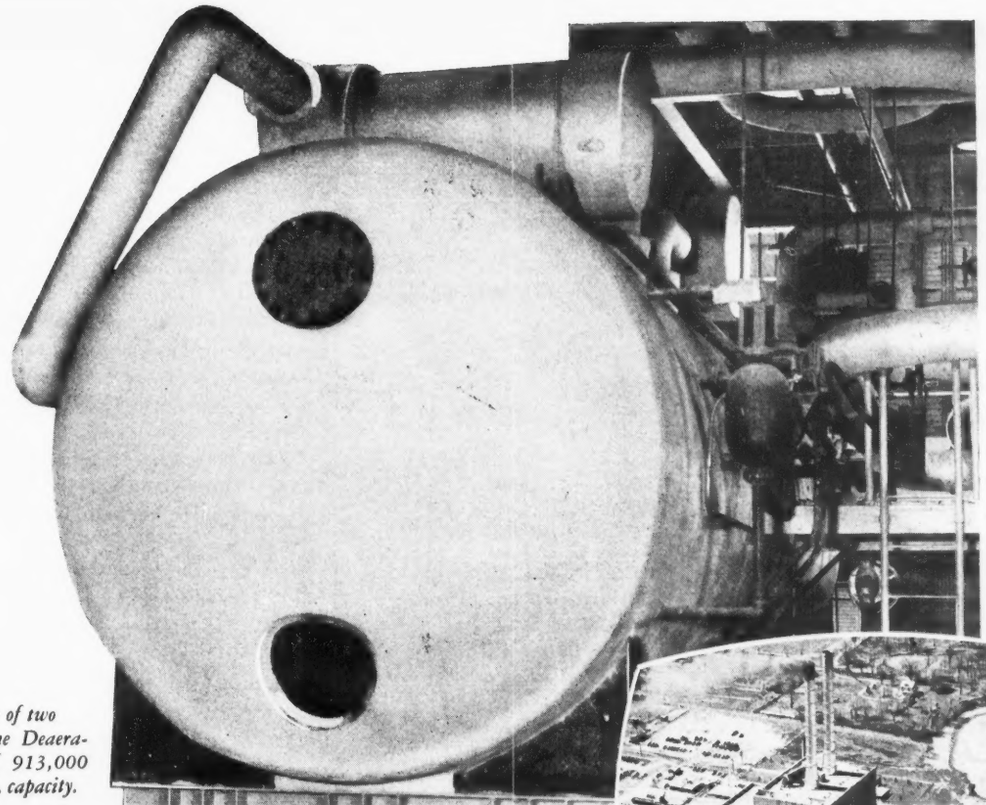
Consumption of Fuel for Production of Electric Energy. Monthly summaries of coal, oil, and gas used by generating plants. Includes stocks of coal on hand and generation by coal as percent of total.

Electric Power Requirements and Supply. Tabular data on peak demand and available capacity published monthly for each power supply area. Quarterly reports present charts showing past, present and projected conditions.

Scheduled Additions and Construction Expenditures. Published annually. Includes summaries of reports by publicly and privately owned utilities as to proposed additions to generating capacity and budgets for all construction expenditures.

Production of Electric Energy and Capacity of Plants. Annual statistics by states on generation and capacity at end of the year by type of prime mover and class of ownership. Includes revisions reported subsequent to monthly reports.

Movement of Electric Energy Across State Lines and International Bound-



One of two Cochrane Deaerators of 913,000 lb./hr. capacity.

(Below) Air view of Oswego Steam Station of Central New York Power Corp.

OSWEGO UNITS NOS. 1 AND 2

CENTRAL NEW YORK POWER CORP.

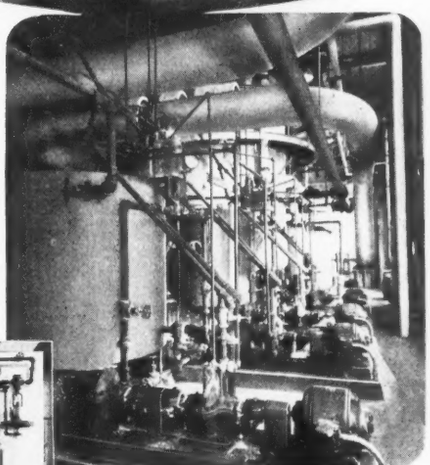
rely on Cochrane Softening & Deaeration

THE Oswego Steam Station of the Central New York Power Corporation has had one of its 80,000 kw. units installed for over a year, and the second was recently placed in operation.

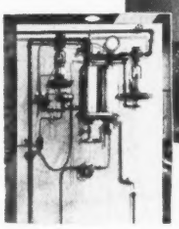
Both these units use Cochrane Feedwater Conditioning Equipment. Cochrane Deaerating Hot Process Softeners prepare make-up for the evaporators and are designed for lime and soda with supplementary phosphate, or for two-stage softening.

Feedwater heating is accomplished in six stages. The first three are direct contact heaters and the last three are closed heaters. The Cochrane Deaerators, as illustrated above, are used as the third stage of direct contact heating and deliver 913,000 lb. per hour with zero oxygen content. Steam from the ninth stage bleed point on the turbine is used in the deaerator.

A new publication on Cochrane Deaerators is just off the press. A copy will be sent on request.



Proportioning Pumps, Chemical Tanks, Filters and Sedimentation Tank of Cochrane Deaerating Hot Process Softener.



(Left) Cochrane Steam Sample Degasifier separates hydrogen from boiler outlet steam, for measuring dissociation of steam into hydrogen and oxygen.

Cochrane Corporation

3106 N. 17th ST. **PHILADELPHIA, PA.**

WATER SOFTENERS • DEAERATING HEATERS • DEAERATORS • BLOW-OFF EQUIPMENT • VALVES • FLOW METERS

Now Available!

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(ANHYDROUS SODIUM SULFITE)

FOR THE REMOVAL OF OXYGEN FROM BOILER FEED WATER

WE ANNOUNCE the immediate availability of REM-OX, a technical anhydrous sodium sulfite, containing 87% available Na_2SO_3, at prices that compare favorably with the commercial product.

REM-OX is packed in 100-lb. multiple bags and 400-lb. wooden barrels for shipment in any reasonable quantity. For further information and prices consult the Philadelphia Main Office, or your nearest Betz representative.

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DEFENSE "PEAKS"

It's heat-proof. Resists pressure, moisture, solvents. Lubricates where other lubricants often collapse. Used alone or in oils, greases.

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Particle Size No. 1—large, lubricous flakes.

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Dixon's Microfyne—microscopically subdivided particles.

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Consumption of Fuel for Production of Electric Energy. Summaries and reported revisions of monthly data. A presentation of the amounts of energy generated by each type of fuel and data on fuel burned per kilowatt hour generated.

Installed Water Power Capacity in U. S. and Outlying Territories. Data on industrial as well as public utility water-power capacity. Classified by ownership and size of installations. Includes summaries for all years of record.

Electric Power Statistics — 1920–1940. This section presents for the first time complete historical data compiled for each year since 1920 as to production of energy, capacity of plants, and fuel consumption.

Potential subscribers should communicate with the Federal Power Commission, Washington, D. C., for additional information.

Sump Size Affects Pump Efficiency

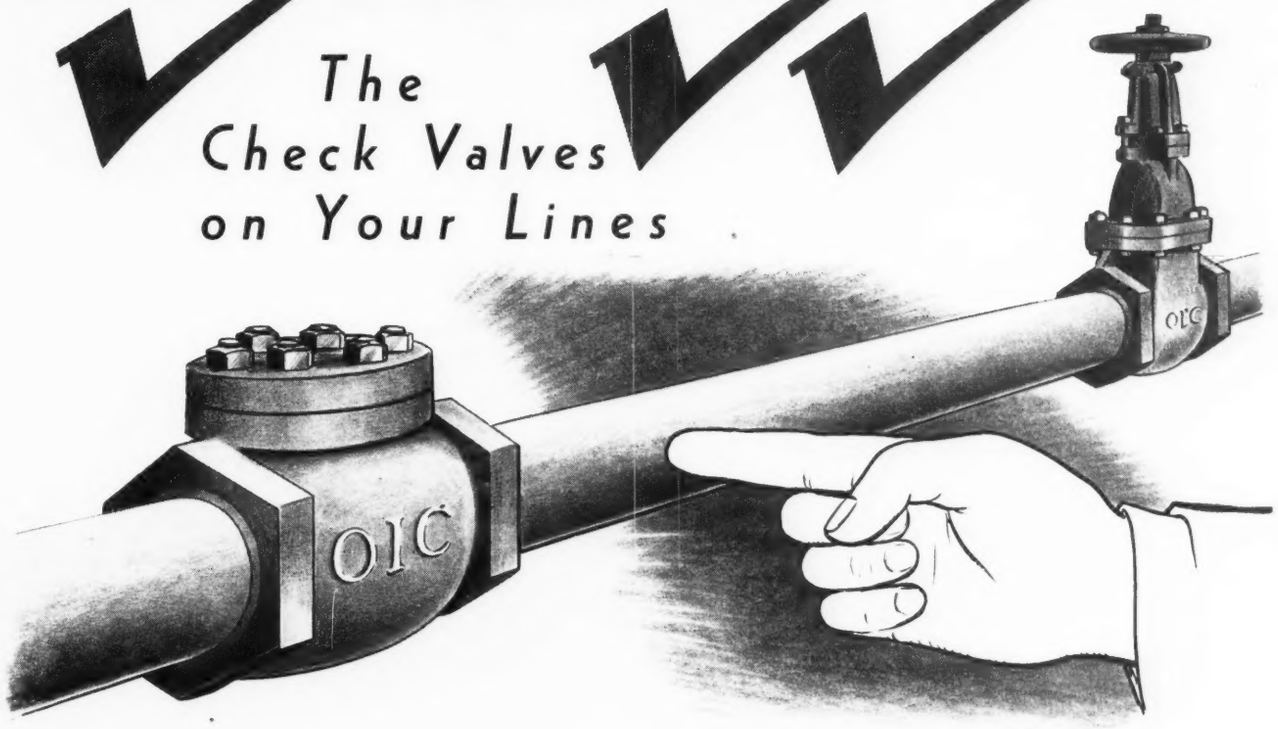
Effect on performance of propeller pumps when installed in sumps of restricted proportions, as compared with results in unrestricted sump areas is extremely interesting, according to evidence of tests recently presented by J M Hait, chief engineer, Peerless Pump Div. Food Machinery Corp. Previous to these tests, it had been assumed that equalized flow conditions of a totally unconfined sump area would result in the most efficient operation of propeller pumps. These tests revealed the error of such assumption. Tests were made with varying distances from the pump suction to the sump floor, with different side-wall clearances, and with flow arrangements restricted and unrestricted. The curves show the results of the tests.

It was found that axial and mixed-flow propeller pumps are more sensitive to velocity distribution at the inlet to the impeller than are centrifugal pumps of lower specific speeds. Objectives of these experiments were to determine the magnitude of change in head and efficiency by different suction arrangements and to discover the least side and bottom clearance necessary if a reduction in head and efficiency is to be avoided.

Practical proportions for a propeller pump sump from the standpoint of efficient operation are such that the side-wall and the sump bottom clearances relative to the suction bell need not

Check and Double Check

The Check Valves on Your Lines



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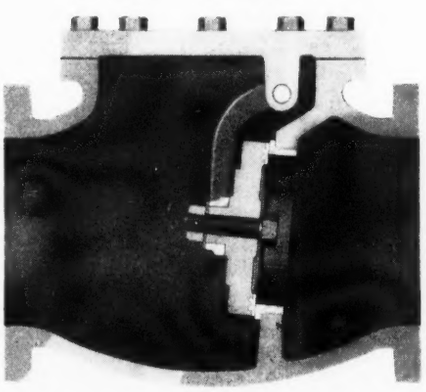

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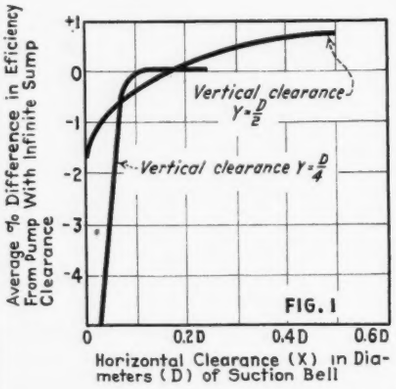
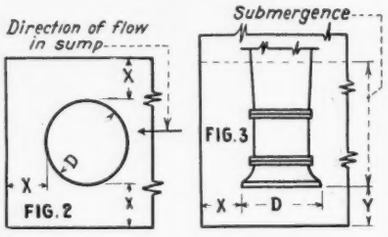
exceed one-half suction bell diameter, Figs. 1, 2 and 3. It was definitely proved that if the sump is installed in a large body of water without appreciable confinement, the operating head and efficiency will be lower.

This investigation shows likewise that





best performance is obtained from propeller pumps when they are installed at the end of a rectangular approach channel with sufficient length to insure uniformly distributed flow parallel to the channel walls without eddies when reaching the pump intake. The multiple-pump installation thus should be such that each pump has its individual approach channel with dimensions as specified for single pumps. These tests, upsetting as they do, preconceived ideas of flow into propeller pump suctions, will no doubt result in widespread changes in propeller-pump-sump design.

Electrical Industry Should Standardize

The national and international emergency demands that American electrical industry simplify and standardize lighting facilities to avoid serious complications in manufacturing, in distribution, and in utilization. Samuel G. Hibben, director of applied lighting, Westinghouse Lamp Div, Bloomfield, N. J., recently told executives attending the Municipal Electric Utilities Convention at Jamestown, N. Y.

In the United States voltage service should be standardized. At the present time electrical service in different cities and localities varies from 110 volts to 125. The demand for 110 volts for light-

"STANDCO" PILLOW BLOCKS

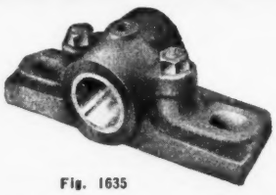
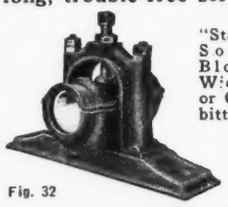


Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth, both faces machined. It can be depended on for long, trouble-free service.



"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

Fig. 32

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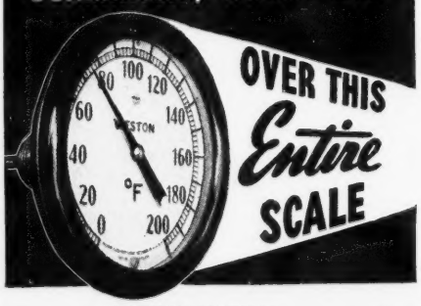

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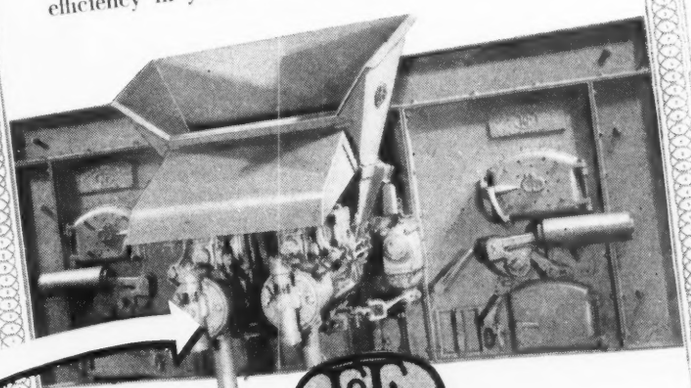

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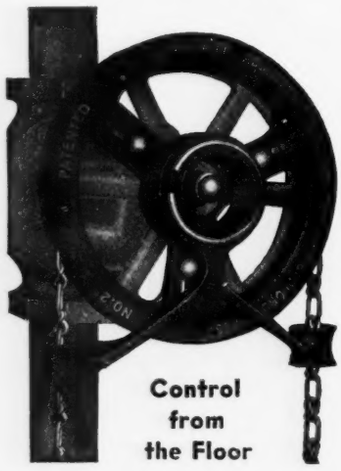

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ing throughout the country represents less than two per cent of the total, for 115 volts a little more than 25 per cent, for 120 volts more than 65 per cent, while the demand for 125 volt service is less than seven per cent. Mr Hibben recommended that voltage service be standardized at 120 volts because the continuation of a plurality of distribution voltages encourages the temptation for adding other nominal voltages.

Engineers' Books

Hydro Power

THE COLORADO CONQUEST (1941), *by David O Woodbury. Published by Dodd Mead & Co, 432-4th Ave, New York, N. Y. 367 pages, 8½x6 in.; illustrated; cloth binding. Price $3.00.*

Boulder Dam on the Colorado River has become almost a national shrine in the minds of the American people. The building of this dam is but the ending of this story to which only 20 pages has been devoted. The real story deals with that period of the conquest of the river when man waged a battle for survival by plain human endurance against a "red bull", as it is called, that sometimes reached flood stages of three-hundred-thousand cubic feet per second. During this battle the outcome was always uncertain and the river frequently won. At one period it poured for two years into the Salton Sea in the Imperial Valley. Against this struggle the author contrasts the building of Boulder Dam as the relentless action of a giant engineering machine, moving like a huge piston into the narrow cylinder of the Colorado canyons. Its outcome was known in advance. Men, machines and materials were coordinated in one beautiful mechanism, set to accomplish a single job. Human intelligence was working at its best, all personal nonsense eliminated. The story begins fifteen million years ago when the Colorado River started to cut a gash in the American continent, splitting its way to the sea through mountain, desert and plain. All this time the Colorado has been tooling its crimson signature into the heart of the oldest rock in the world. Then came man. First the Indians who handed down to us their experience with the red bull in their legends. White man

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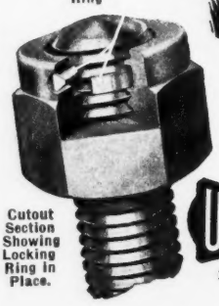

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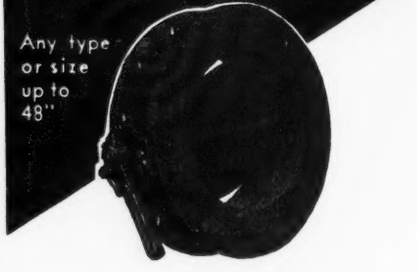

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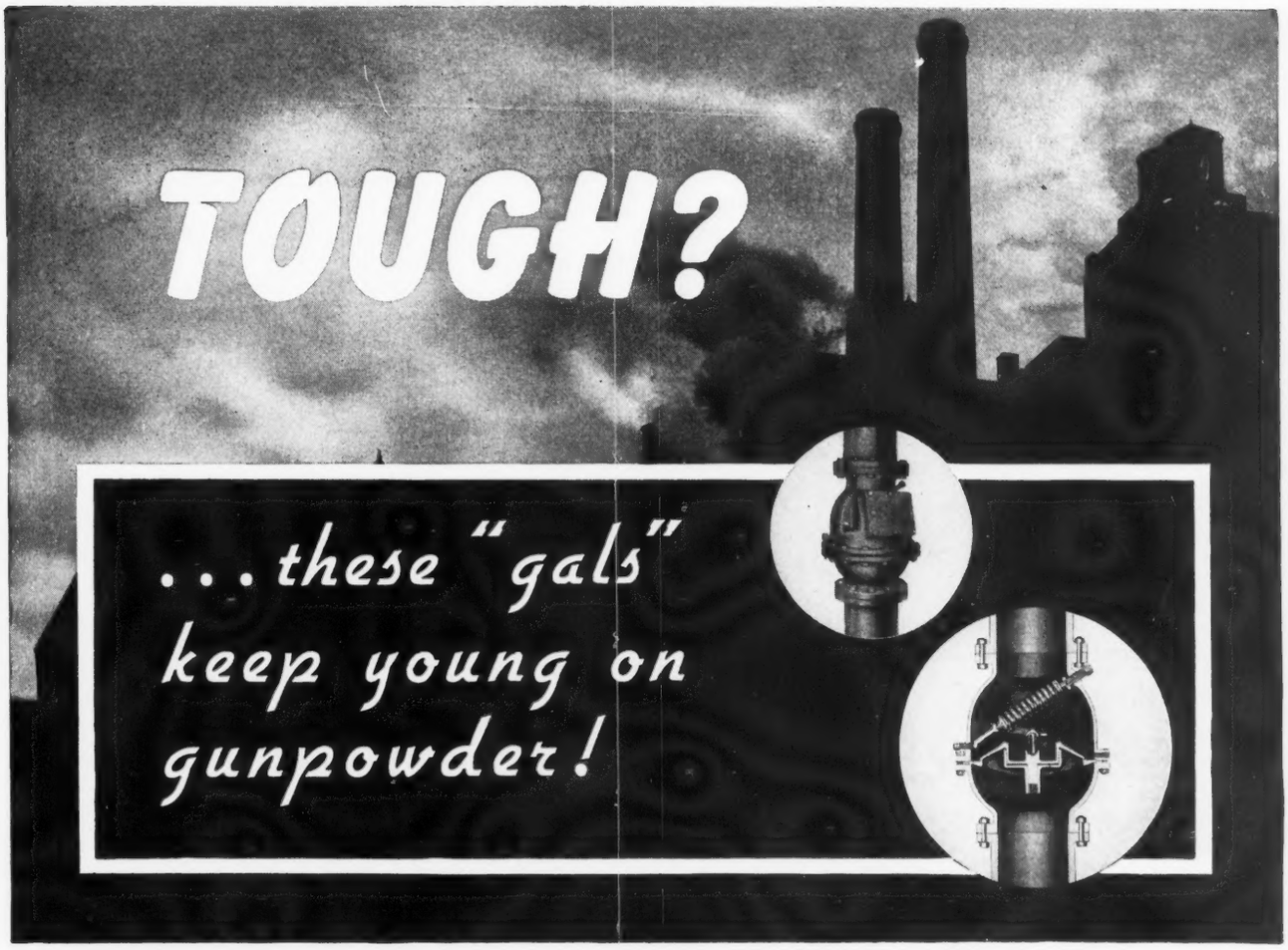

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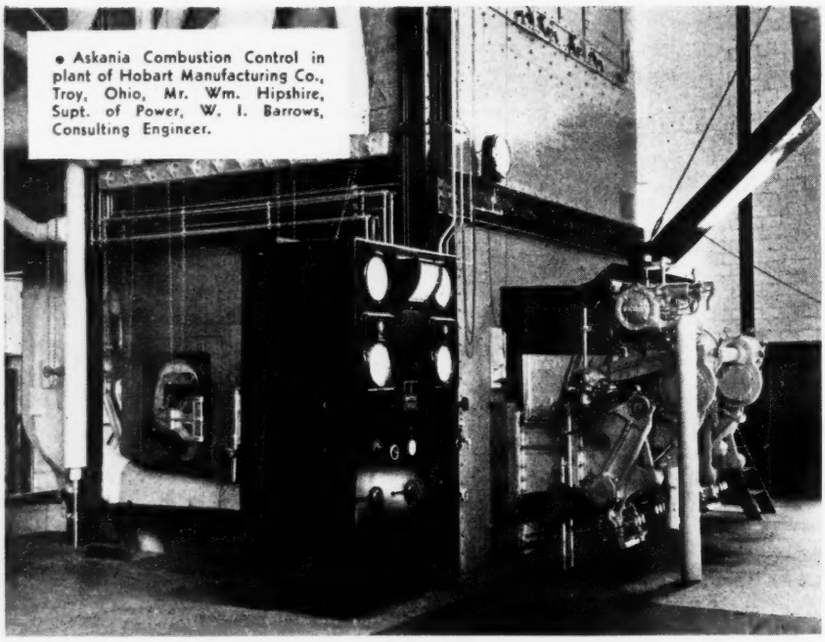

• Askania Combustion Control in plant of Hobart Manufacturing Co., Troy, Ohio, Mr. Wm. Hipshire, Supt. of Power, W. I. Barrows, Consulting Engineer.

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ASKANIA *Combustion* CONTROL

discovered the river, attempted to explore it and one of the most gigantic battles in history began, which was won only by the construction of Boulder Dam. Every element of embattled American democracy is involved in it, the politics, the loves and hates and ambitions of men, the engineering, the finances, the business struggles, the courageous war with nature at her worst, and the betrayal of sincere people by their own leaders and by their Government. This is another of the great popular books of recent years written around facts, and one that will thrill every red-blooded human and make every engineer proud of his profession.

Hotel Engineering

HOTEL ENGINEERING, VOL 2—ELECTRIC CURRENT CONSUMPTION, COST AND SAVINGS. *By Georges C St Laurent, Wegg & St Laurent, Consultants. Published by American Hotel Association, 221 West 57 St, New York, N. Y. 44 pages, 8½x11 in., paper cover. Price $1.50.*

Second volume of the American Hotel Association's series on Hotel Engineering points out that electric-current cost in hotels is three times greater than the cost of water, and, like the water expense, is steadily increasing. This increase is not due to higher electric rates but results from extensive air conditioning, more elaborate illumination, and electric cooking, necessary if hotels are to maintain high service standards.

A feature of the book is the tables showing electric-current consumption of 324 hotels, grouped according to the factors affecting usage, which, the survey shows, are air conditioning and large banquet and restaurant operations rather than rate of occupancy. Wherever possible the tables give a breakdown between light and power, and show in detail the amount of important electric equipment used, such as number of tons of air conditioning and refrigeration, number of elevators regularly used, horsepower of ventilating fans and central vacuum-cleaning plants, total wattage of roof signs, amount of electric cooking, and other important items.

Other interesting sections describe how a hotel operator may conduct his own survey of electric operations and list various ideas for eliminating waste and cutting electric costs. The proper approach to the utility rate problem is discussed, together with questions

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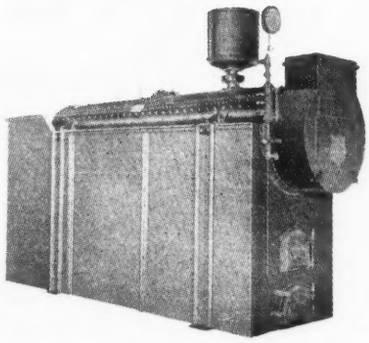

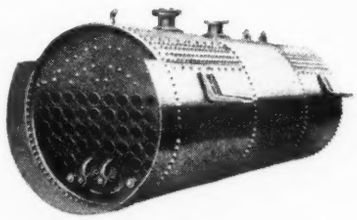

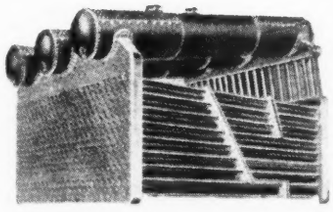

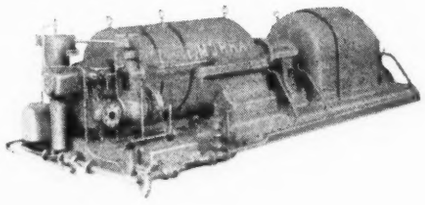

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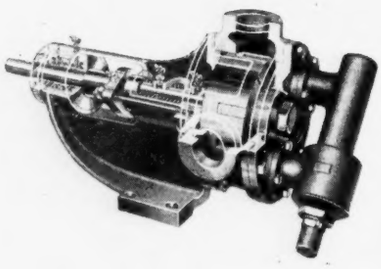

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such as private generation compared with purchased power, and electric compared with gas cooking.

A number of pages are devoted to reviewing some of the latest developments in the electric industry that are applicable for hotel use, such as fluorescent lighting, individual refrigerating units for restaurant requirements, individual room air-conditioning units, automatic-control devices, and electric submetering.

Particular attention is placed on the possibilities of the diesel engine for power generation and for driving large pieces of equipment such as refrigerating compressors. While some might dispute the cost figures cited and regret the failure to mention use of diesel engines in combination with steam-power equipment, the discussion is, in general, well presented. The author draws attention to the use of diesel waste heat for hot-water production, a point often overlooked, and properly stresses the importance of a thorough and competent engineering analysis of the entire power-generation problem.

Electricity

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS (Seventh Edition—1941). *Editor-in-Chief Archer E Knowlton; assistant editor R M Shoop. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 2303 pages, 6x9 in.; profusely illustrated; many tables; semi-flexible binding. Price $8.00.*

Like P T Barnum's circus, the seventh edition of this handbook is bigger and better than ever before. The new edition has 2203 pages 6x9 in. in size compared to 2816 pages of 4x6¾ in. dimensions. The larger size pages permit using bigger type and illustrations, making the new book more readable and useful. According to the editor's preface, over 100 electrical engineers in diversified professional activities were interviewed to ascertain what practicing engineers expected in an electrical-engineering handbook. Thus, these current users of previous editions of the handbook set the pattern for the new edition, practically new in content from cover to cover. The majority of the contributors are new, but all have been selected with the object of getting a presentation of subjects that is not only new but geared to the immediate needs of practicing engineers. Prominent among the changes in this edition is an expansion of the former section on power-plant elec-

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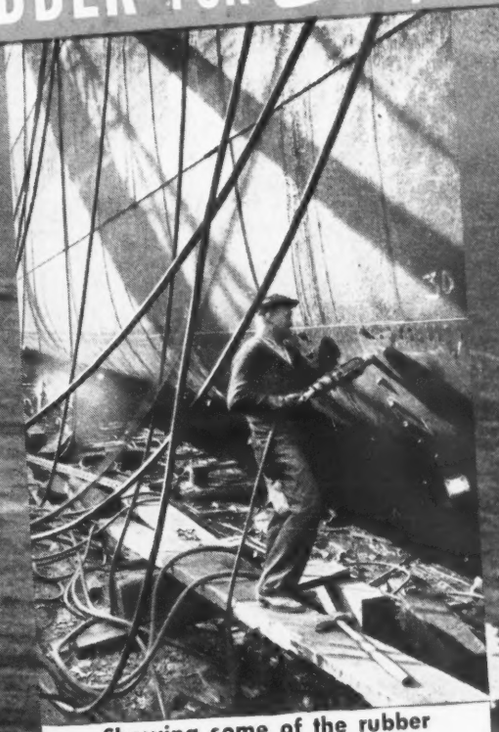
Read POWER Regularly

FROM THE *Ways* TO THE *Waves*—

MANHATTAN HELPS WITH "RUBBER" FOR *Ships*



Showing some of the rubber hose used in building a ship.

In the shipbuilding miracle that is about to reach an output of a ship a day, "rubber" plays an essential part.

As blueprints are being transmuted to metal at a pace that will produce a two-ocean navy months ahead of schedule, "rubber" is revealed not only as a critical material, but as a prodigy in its own right.

"Rubber" is not *one* material, but an array of materials, born of research and bred of experience in laboratories like MANHATTAN'S. Here, new compounds were pioneered, tested and retested and then proved in services where nothing else would do as well.

Natural and synthetic rubbers which resist oils, gasoline, salt water and chemical action have speeded the building, servicing and sailing of ships.

Hulls are welded, rivets driven, oil bunkers filled, engines are fed, channels are suction-dredged, vibration is dampened, submarine battery compartments are protected, propeller shafts rubber covered, salt water systems rubber lined, gun decks given foot security, exhausts in diesel-driven craft are almost silenced and given added years of life—all with rubber.

Hoists and cranes are controlled with asbestos friction material. Weld burrs and castings are ground smooth with abrasive wheels—rubber bonded and vibration dampened to reduce fatigue, to speed production.

A whole succession of improved or new products—pioneered and developed by MANHATTAN—is now "in training" for industry.

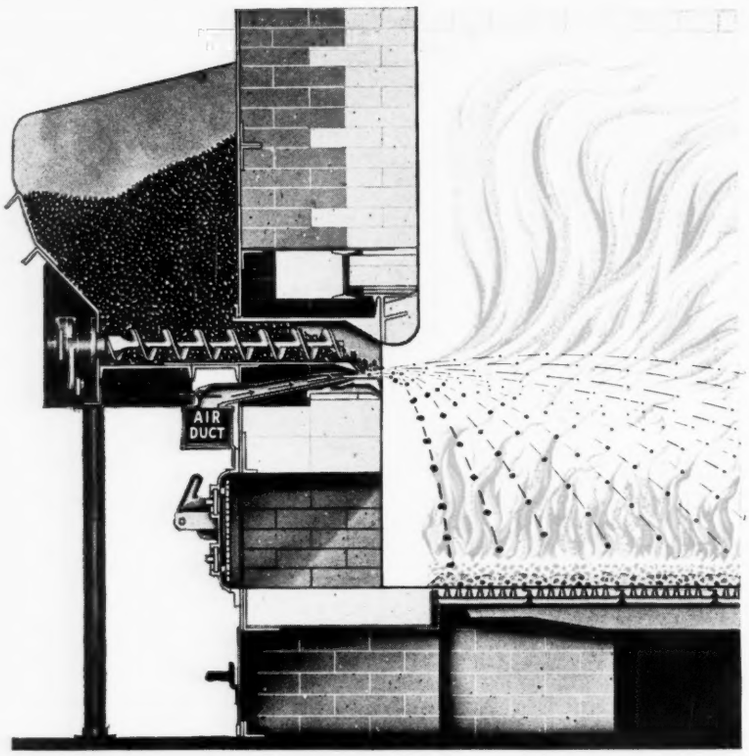
A Few of Many MANHATTAN Products for Ship and Yard

- Porthole Rubber
- Rubber Tiling
- Packing and Gaskets
- Fire Hose
- Air, Steam, Water Hose
- Welding Hose
- Paint Spray Hose
- Marine Exhaust Hose
- Rubber Deck Coverings
- Rubber-Lined Tanks
- Rubber-Lined Salt Water Systems
- Asbestos Electric Cable Insulation

KEEP AHEAD WITH MANHATTAN

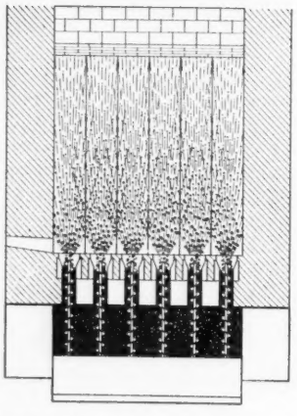
THE MANHATTAN RUBBER MANUFACTURING DIVISION
of RAYBESTOS-MANHATTAN, INC.
EXECUTIVE OFFICES and FACTORIES • • • PASSAIC, NEW JERSEY

You Can See the SUPERIORITY!



YOU don't have to be an authority on boiler firing methods to see why the *exclusive* FYR-FEEDER method is superior to conventional methods. Jets of air do the actual work of spreading the coal and you can imagine what a perfect condition this creates for combustion: fines burn in suspension, larger coal burns on grate . . . air is supplied right where it does the most good . . . virtually perfect turbulence is maintained in the furnace . . . fluctuating loads can be handled with ease!

You get this kind of firing from the multi-burner FYR-FEEDER with minimum expense: no crushers or pulverizers to buy . . . no high pressure air needed . . . low initial cost . . . very low maintenance and operating cost. FYR-FEEDER Spreader Stokers pay for themselves by burning cheaper coal! Write today for complete information.



THIS plan view of a 6-Burner FYR-FEEDER shows the excellent coal distribution pattern. Contrast this with other spreading methods that throw heavy pieces of coal the greatest distance and with greatest force.

AMERICAN COAL BURNER COMPANY
151 E. Superior St., Chicago, Ill.

The **FYR-FEEDER**
INDUSTRIAL SPREADER STOKER

trical equipment to include apparatus for the whole system. This one section alone might be considered a power system handbook in itself. Power transmission, electronics and radio, interior wiring, illumination, prime movers and telephone are other basically new treatments. Recognition is also given to such modern developments as air conditioning, electricity in aviation and in the petroleum industry, lighting technology, high-voltage generators and cyclotrons. The compilation of codes and standards has been expanded so that users may know where to obtain standard specifications and prescribed practices. An enlarged and improved index completes this new encyclopedia of applicable electrical-engineering information.

Bearings

HANDBOOK OF SLEEVE BEARINGS—1941. *By Albert B Willi, chief engineer, Federal-Mogul Corp, Detroit, Mich. Published by Federal Mogul Corp, Detroit, Mich. 219 pages, 6¼x9¼, photographs, drawings. No price listed.*

This handbook discusses the effect of design, alloys and manufacturing methods on sleeve bearing efficiency, and defines the field of application for each basic type of sleeve bearing. It contains information, which, from experience, engineers, designers and draftsmen will welcome as a guide to bearing design and selection.

One complete section lists innumerable sizes and types of bearings and bushings for which major manufacturing tools are available.

This handbook is the result of years of specialization in the field, and the job of gathering this information between two covers itself has taken two years. Because its cost was considerable, publishers are making the handbook available only to those directly concerned with sleeve-bearing design and application.

LEFAX DATA—*Published by Lefax, Inc, Philadelphia, Pa.* Recent additions to Lefax data of interest to power men include Order No. 41-13, "Bend Allowance for Flanging Material"; No. 30-107, Rivet Sizes and Weights"; No. 30-6, "Weights and Areas of Steel Concrete Reinforcing Bars for Various Spacings"; No. 15-21, "Heating Effects of Currents"; No. 19-28, "Surface Hardening of Steels"; and No. 8-106 "Diagonal Tension and Shear."